

CONSUMPTION OF FOOD SUPPLEMENTS IN THE FES-MEKNES REGION, MOROCCO. PROFILES AND TYPOLOGY

Hamza El Finou¹, Nadia Salhi¹, Abdelhamid Zaid¹, Lhoussaine El Rhaffari¹

¹Department of Biology, Laboratory of Bioactives, Health and Environment, Moulay Ismail University of Meknes, Faculty of Sciences, Morocco

ABSTRACT

Background. The consumption of food supplements is increasing. This evolution is due to several factors, including nutritional deficiencies in the population, a sedentary lifestyle, and a decrease in physical activity. In addition, stress and an active lifestyle led to several dysfunctions (fatigue, deconcentration) that food supplements can help to overcome.

Objective. This study aimed to determine the profiles of food supplement consumers in the Fes-Meknes region (Morocco), distribution, and production of these products. In addition, this survey aimed to evaluate consumers' knowledge of food supplements as part of their self-medication.

Material and methods. The present study was conducted in the form of a survey using a questionnaire composed of two parts. The first part provides information on the socio-demographic status of respondents, including gender, age, and level of education. The second part concerned various information on the consumption of food supplements.

Results. The results obtained showed that of the 498 subjects, 68.88% declared that they had already consumed the food supplements. The study revealed the predominance of the female gender at 69.68% and the age group 21-30 years (80.32%). Among the reasons for consumption, improving general health comes first with 56.29%. Our results also showed high consumption of vitamins (44.04%) and minerals (24.79%), next come proteins and plant extracts at 16.62% and 14.54% respectively. The consumption of food supplements is most often done on the advice of a doctor or dietician with 43.60%, and the pharmacy and para-pharmacy remains the main distribution channel at 75.78%.

Conclusion. The present survey allowed us to update the current situation of food supplement consumption and a way of regulatory monitoring and more control for an organization of the sector.

Key words: *consumption, food supplements, health, minerals, vitamins, self-medication*

INTRODUCTION

The concept of nutrition is now part of our daily lives. Faced with the rise of sedentary lifestyles, the growth of food, and the emergence of alternative medicines, the food supplements (FS) market is booming in many developed countries [1]. The pharmaceutical and food industries offer a wide range of food supplements that include several products of various forms and uses. As these forms are very similar to drugs in their galenic form, the difference between a drug and dietary supplements is becoming less and less obvious. These forms represent today a real challenge to satisfy and retain the consumer.

The consumption of food supplements continues to grow both nationally and internationally. This is due to several factors including the awareness of the need for these products for people who follow

specific nutritional diets, as well as the development of the sports sector (gyms and fitness) that make their customers aware of the body discipline sometimes requiring the intake of food supplements [2]. Finally, stress and an active lifestyle led to several dysfunctions (fatigue, deconcentration) that nutritional supplements can help to overcome.

The COVID-19 pandemic has created widespread psychosis and anxiety. The consumption of FS increased (Vitamin C, A, and Zinc) due to the supposed role of micronutrients in strengthening immunity to cope with this pandemic. The purchase and consumption of aromatic and medicinal plants also increased during this period [3]. Faced with this situation, the practice of self-medication has increased. For this, many substances have been used without medical advice. Indeed, a recent study in Togo showed that about one out of three people had used this practice to prevent

Corresponding author: Hamza El Finou, Bioactives, Health and Environment Laboratory, Moulay Ismail University of Meknes, Faculty of Sciences, Department of Biological Sciences, 11201- Meknes, Morocco. Tel: + 212 6 26 51 66 46, e-mail: h.elfinou@edu.umi.ac.ma

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COVID-19 [4]. Another study in Bangladesh found that the prevalence of self-medication during the COVID-19 epidemic was 88.3% [5]. In Kenya, the prevalence of self-medication increased from 36.2% before the pandemic to 60.4% during the pandemic [6]. that the use of dietary supplements is part of self-medication worldwide. In our study, we focused on the population of the Fes-Meknes region (Morocco), but according to previous studies, it is evident that the world population has the same tendency to practice self-medication.

FS are typically healthy compounds that present no potential danger. This indicates that consumers can use them without risk. However, some studies of their physiological effects, have reported their potential risks on body functioning, especially in the absence of nutritional deficiencies [7]. Thus, the consumption of FS must not exceed the maximum recommended levels. As a result, excess consumption can be harmful to health in the long term. Any supplementation must be under the supervision of a health professional and any intake without supervision may present health risks [8].

Since food supplements are potential sources of nutrients and other bioactive compounds, it is important from a public health perspective to know who is consuming them, what types, and under what circumstances. For this, the main aim of this survey is to evaluate the profiles of FS consumers, and the production and distribution of FS, to update the current situation of FS consumption, and provide new data concerning this sector, particularly in the Fes-Meknes region in Morocco.

MATERIAL AND METHODS

Study context

The survey was carried out in the Fez-Meknes region during the 2020-2021 academic year. A network of students allowed us to distribute the questionnaire in the different cities of the region via the Internet and in the field, which allowed us to interview 498 subjects in 4 months. In addition, the second phase of our survey was carried out with 70 pharmacists to have information related to the production and distribution of food supplements.

The inclusion criteria for this study were the consumption of FS (343 subjects). While the non-consumers of FS were excluded from the analysis process (155 subjects).

SURVEY PROCEDURE

From February to May 2021, a cross-sectional, anonymous, and descriptive study was conducted online and in the field with 498 citizens from different cities in the Fez-Meknes region (Morocco). All participants accepted the use of their responses for publication and scientific studies. An email invitation

to participate in the survey containing a link to the online questionnaire was sent to students, teachers, health professionals, and others. The first page of the questionnaire contained an implied consent statement, although participants were free to accept or decline participation as they saw fit. The survey gathered information on:

- General information on the socio-demographic status of participants, including gender, age, level of education, etc.
- The age has been classified into 4 classes: under 20 years; 21-30 years old; 31-40 years old; 41-50 years old and over 50 years old.
- The FS consumption mode section consisted of 10 questions. It discussed the different types of FS consumed by participants. These types have been grouped into standardized categories (Vitamins/minerals/proteins and FS from plants/plant extracts).
- In addition, the participants who previously or currently used food supplements (even a few years ago) are considered consumers, while those who answered never are considered non-users.
- For the variables that concerned the consumption of the FS, the analysis concerned only the consumers.
- It also included questions on the method of consumption (frequently (many times), occasionally (accidentally), and regularly (on an exact prescribed diet), the purchase recommendation (advised by a friend, medical prescription), places of purchase (Pharmacy/Para pharmacy, specialized surfaces, supermarkets, Internet), and consumer expectations (improve general health, filling a deficiency, coping with a disease).

Data collection

“Google Forms” was used to design and develop the questionnaire form. The answers that were added were automatically collected, arranged in a file, and then converted to Excel format. Preliminary to the survey’s administration, a pilot study was conducted on a sample of 60 participants to confirm the reliability and validity of the questionnaire. As a result, changes were made to several of the survey questions to make it easier for respondents to understand the questions.

Statistical analysis

The Statistical Package for the Social Sciences (SPSS) Version 20 was used to conduct the statistical analysis. While qualitative variables were expressed as percentages (number of people that used the study modality/total population), quantitative data were expressed as means. The *Chi-square* test was conducted to see if any categorical differences merited further investigation, such as the association between FS consumption and certain variables. Statistical significance is defined as a p-value <0.05.

RESULTS

Socio-demographic data of consumers

The sociodemographic data of the participants and the mode of FS consumption data are presented in Table 1. Of the 498 participants, 68.88% reported consuming FS (343 subjects). Regarding the gender and age of consumers, we obtained a dominance of the female gender at 69.68% against 30.32% of men and the age group 21-30 years old at 61.81%. In addition, 69.97% of consumers had a university level of education.

Circumstances for buying food supplements

The consumption of food supplements is most often done on the advice of a doctor, dietician, or psychologist with a percentage of 43.60%, then the consumption of food supplements by own initiative of the consumer at 29.94%. While the consumption following recommendations from relatives presents only 16.57%, and the consumption after reading articles or television programs presents a percentage of 9.88% (Figure 1).

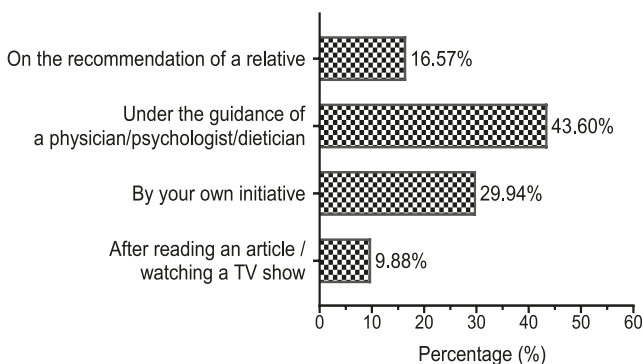


Figure 1. Circumstances for buying food supplements

Currently, the free sale in pharmacies/para-pharmacies, in specialized supermarkets, and on the Internet, has greatly facilitated consumers' access to food supplements. The results obtained showed that 75.78 % of consumers buy food supplements in pharmacies.

Most consumed components of food supplements.

The results obtained showed high consumption of vitamins (44.04%) and minerals (24.79%). Next, come proteins and plant extracts at 16.62% and 14.54% respectively (Figure 2). Among the consumer participants, 125 of them (36.44%), were able to give the exact names of the supplements they use. Table 2 shows a descriptive analysis of the composition and functions of some food supplements cited by consumers.

Table 1. Summary of the socio-demographic and FS consumption data

Variables	Percentage %
Gender	
– Male	30.32
– Female	69.68
Age	
– Under 20 years	02.92
– 21-30 years	61.81
– 31-40 years	18.95
– 41-50 years	04.37
– Over 50 years	11.95
Level of education	
– Illiterate	07.87
– Primary school	04.66
– High school	17.49
– University	69.97
Frequency of consumption	
– Frequently	13.31
– Occasionally	71.67
– Regularly	15.01
Food supplements acquisition places	
– Pharmacy/Para pharmacy	75.78
– Specialized surfaces	07.69
– Supermarkets	05.41
– Internet	05.41
– Stores	05.70
Reasons given for taking food supplements	
– Improve general health	56.29
– Filling a deficiency	25.89
– Coping with a disease	17.81
Symptoms treated with food supplements	
– Blood circulation	04.47
– Digestion and intestinal transit	14.78
– Reinforcing natural defences	16.84
– Weight loss and/or gain	20.27
– General tiredness	43.64
Consumer satisfaction after consuming food supplements	
– Satisfied	57.10
– Partially satisfied	32.24
– Unsatisfied	10.66
Average price of food supplements	
– Between 100 and 200 MAD	61.43
– Between 50 and 100 MAD	31.43
– More than 200 MAD	07.14
Evolution of the demand for food supplements in the last 5 years	
– No idea	07.14
– Growing	70.00
– Descending	04.29
– Almost stable	18.57

Table 2. Descriptive analysis* of some food supplements cited by consumers

Food Supplement	Category	Composition	Function
Supradine	Multi-vitamin	Vitamins (A, B ₂ , B ₆ , B ₁₂ , C, D, E, K) Minerals (Zn, Mg, Cu, Ca). Coenzyme Q10	Energizer
Docivox	Natural syrup	Natural active ingredients (Thyme fluid extract)	Soften the throat, soothe the respiratory tract and strengthen the natural defences.
Tardyferon	Micro-nutrients	Iron Ferrous Sulphate Folic acid	Treatment of anaemia and iron deficiency
Whey	Source of proteins	Amino acids	Protein for athletes
Nurax	Appetite stimulant	Fenugreek, dry extract of gentian, Iron, Wheat germ, 12 vitamins	Appetite stimulant
Additiva	Multi-vitamin	Vitamins (A, B ₁ , B ₂ , B ₆ , B ₁₂) Minerals, Pantothenic acid	Vitamin supply
Forcapil	Micro-nutrients	Zinc, Vitamin B ₈ Vitamin B ₉	Hair and nail care
Nuravit	Appetite stimulant	Vitamins (B ₁ , B ₂ , B ₆ , C)	Appetite stimulant
Omega-3	Fatty acids	Omega-3	Development and function of the retina, brain, and nervous system
Levure de bière	Appetite stimulant	Non-pathogenic microscopic fungi (<i>Saccharomyces cerevisiae</i> and <i>Candida utilis</i>)	Regulators of intestinal transit and loss of appetite
Relaxium	Micro-nutrients	Magnesium Vitamin B ₆	Micro-nutrients

*: The descriptive analysis was based on the notices of each food supplements (consulted in pharmacies).

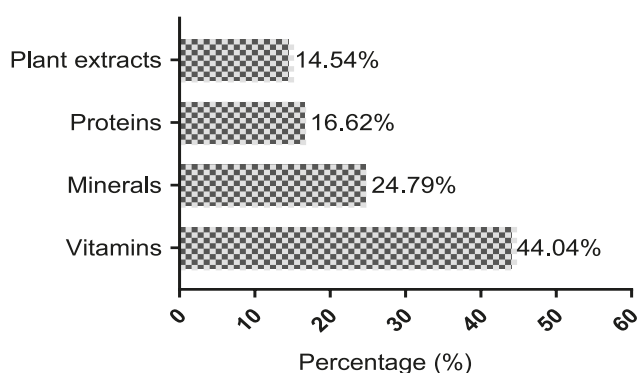


Figure 2. Most consumed components of food supplements

Production and distribution of food supplements

During the second phase of the survey, conducted among 70 pharmacies and para pharmacies in the Meknes region, the distribution and production of dietary supplements were identified. The results showed that the most marketed food supplements were intended for cosmetic and wellness use (32.2%) and skin care (46.6%). Then comes hair care at

21.2%. According to the producers interviewed, the food supplement market has developed over the past 5 years. The results show that the average prices of these products are between MAD 100 and MAD 200 at 61.43%, between MAD 50 and MAD 100 (31.43%), and 7.14% for products above 200 MAD (Table 2).

The raw material used for the production of these products is of both Moroccan and foreign origin. Supplier markets are European (56.23%), American (22.14%), Asian (16.72%), and African (4.91%). The growth in demand for food supplements has been observed over the past 5 years by 70% of producers interviewed. Interviews conducted at the pharmacy level showed that 82.9% of clients are young, confirming the results obtained with consumers (Table 2).

Association of FS consumption with some variables.

The *Chi*-square test was performed to reveal any association between the consumption of FS and other variables (Table 3). The results obtained showed that the consumption of FS varies depending on the age of participants ($Chi^2=9.48$; $p=0.002$), the education level

Table 3. Summary of the association of FS consumption with some parameters studied

Variables	Percentage %	Chi ²	P-value
Gender			
– Male	30.32	3.84	0.441
– Female	69.68		
Age			
– under 20 years	02.92	9.48	0.002
– 21-30 years	61.81		
– 31-40 years	18.95		
– 41-50 years	04.37		
– Over 50 years	11.95		
Level of education			
– Illiterate	07.87	7.81	0.000
– Primary school	04.66		
– High school	17.49		
– University	69.97		
Frequency of consumption			
– Frequently	13.31	5.99	0.147
– Occasionally	71.67		
– Regularly	15.01		
Food supplements acquisition places			
– Pharmacy/Para pharmacy	75.78	9.48	0.976
– Specialized surfaces	07.69		
– Supermarkets	05.41		
– Internet	05.41		
– Stores	05.70		
Consumer satisfaction after consuming food supplements			
– Satisfied	57.10	5.991	0.000
– Partially satisfied	32.24		
– Unsatisfied	10.66		

($Chi^2=7.81$; $p<0.001$), and the satisfaction of consumers ($Chi^2=5.991$; $p<0.001$). It was also observed that no significant association between the FS consumption and gender ($Chi^2=3.84$; $p=0.441$), the FS acquisition places ($Chi^2=9.48$; $p=0.976$), and the frequency of consumption ($Chi^2=5.99$; $p=0.147$).

The preferred design of the FS for consumers

Consumers preferred tablets first at 37.2% followed by capsules at 28.5%. In addition, some consumers preferred drinkable suspensions (15.6%), flavored drinks, and infusions (12.8%). While pastilles were the least used at 5.9% (Figure 3).

DISCUSSION

Considering all the results obtained in this study, it is obvious that the consumption of dietary supplements is widespread in Morocco. Our results showed that of 498 participants, 68.88% were FS consumers. In addition, the dominance of females at 69.68% against 30.32% of men's gender and the age group 21-30 years old at 61.81%. In this context, *Jamal* [9] conducted a survey in 2015 in Morocco with 504 volunteers and found that 46% of the subjects were consumers [9]. Other studies have also confirmed this trend [10, 11]. Contrary to the results obtained by *Naqvi* et al. [12], who analyzed the food supplement intake in the public and private sector at the pharmacy teaching universities of Karachi (Pakistan), and found that 51% were male, and 47.3% were female. By age groups, the highest figure was reported in the age group 27-30 years [12]. The consumption of food supplements also varies according to region. Thus, it is in the northern and central regions (Casablanca, Rabat, Marrakech, and Tangier) that we have the largest number of consumers [9]. On the other hand, in the South, the demand is almost non-existent. Our study also confirmed this hypothesis by the large number of consumers found in the Fez-Meknes region. From the point of view of consumer satisfaction after taking food supplements, we obtained that only 32.24% proved great satisfaction; while the study of *Jamal* [9], showed that about 90% of subjects said that the consumption of food supplements met their expectations [9].

For the circumstances of purchases, our study revealed that the consumption of food supplements is

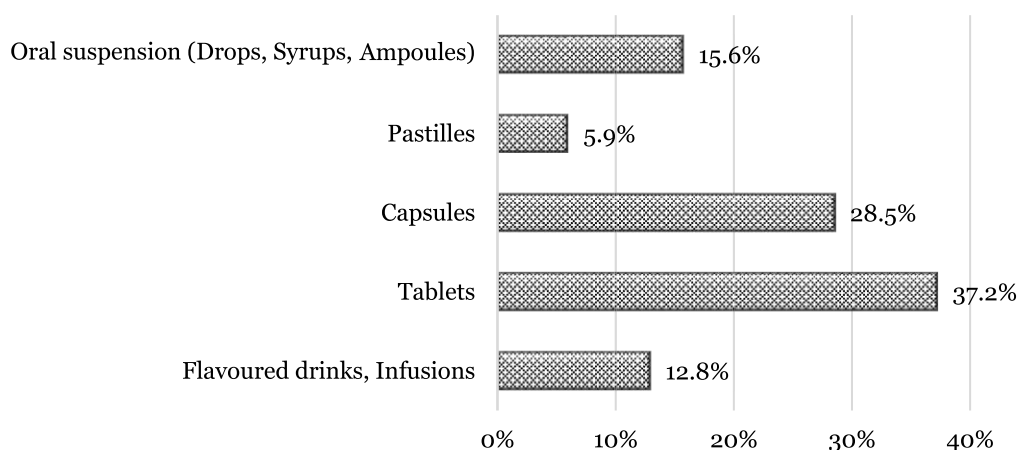


Figure 3. The preferred design of the FS for consumers

often done under the advice of a doctor or dietician with a rate of 43.60%, the taking of supplements by the consumer's initiative comes in second place at 29.94%. Another study conducted by *Pouchieu* et al. [13], showed an important part of self-medication, and nearly one consumer out of two took food supplements as self-medication, 21% bought supplements under medical advice, and 33% under medical prescription. A health professional generally recommends the use of food supplements [14].

According to the data obtained from the Syndicate of Dietetics and Supplements [15], the pharmacy remains the leading sales channel for food supplements in France, compared with direct sales on the internet, specialized stores, large and medium-sized retailers, and Para pharmacies. Our results also confirmed this tendency, from which we obtained that 75.78 % of consumers buy food supplements in pharmacies.

According to the results obtained in this study, it is most often a high consumption of vitamins, micronutrients, energizers, and minerals. Vitamins and minerals have a great variability in their complementary intakes, with the highest contributions concerning vitamin D, vitamin B₁, and vitamin C. In this context, several studies have also shown that the most commonly consumed nutrients in the form of supplements were magnesium, vitamin B₆, vitamin C, zinc, and iron, whereas omega-3 fatty acids and herbal supplements were consumed quite lowly [16]. Thus, according to *Nakhal* et al. [17], fish oil (omega 3) was the highest food supplement used at 18.02%, followed by Glucosamine, Chondroitin, Cranberry, and fiber with percentages at 12.11%, 11.83%, 9.29%, and 8.45%, respectively. In addition, 76% of the participants indicated that they recommend herbal food supplements to their friends/families, and patients [17].

The importance of applying rigorous regulations concerning the sale and purchase of FS is essential, because, As opposed to popular belief, excessive consumption of protein and amino acids can be potentially very harmful to our health as they can cause disorders of the bone system, impaired kidney function, increased risk of cancer and impaired liver function and can lead to coronary heart disease [18]. In addition, *Rutkowski* and *Grzegorzczuk* [19] also reported the deleterious effects of excessive supplementation with antioxidants especially synthetic ones (Vitamin A, E, C, and β -carotene) which are often used in many preventive and curative medical treatments. However, they can cause hypervitaminosis and even a potentially toxic effect [19].

CONCLUSION

The present survey allowed us to bring new data concerning the food supplements sector in Morocco, in particularly the Fez-Meknes region, by studying several parameters related to the consumption, production, and distribution of these products. The FS supports a healthy diet and helps prevent disease, but uncontrolled consumption can be harmful and ineffectual in the absence of vitamin or mineral deficiencies. In this approach, the health professional remains a key player and must educate consumers on the benefits as well as the risks associated with taking food supplements. In this sense, the provision of clear and validated information is a very effective tool. In this study, the restrictions and sanitary measures concerning COVID-19 were a limit in front of the conduct of our survey. Thus, the participant's personal life was sometimes a major obstacle to access to complete information.

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Conflict of interest

The authors declare that they have no conflict of interest regarding this article.

REFERENCES

1. *Tran S, Calabretto JP, Sorich M.* Consumer-pharmacist interactions around complementary medicines: Agreement between pharmacist and consumer expectations, satisfaction and pharmacist influence. *International Journal of Pharmacy Practice* 2013;21(6):378-385. <https://doi.org/10.1111/ijpp.12027>.
2. *Garthe I.* Dietary supplements and elite athletes: when nature becomes high risk. *Curr Opin Endocr Metab Res.* 2019;9: 66-73. <https://doi.org/10.1016/j.coemr.2019.07.004>.
3. *Boudia F, Dali Ali A, Mekaouche FZN, Fetati H, Senhadji I, Chaib H,* et al. Automédication et conseil pharmaceutique en période de pandémie de COVID-19 à Oran [Self-medication and pharmaceutical advice during the COVID-19 pandemic in Oran]. *Algerian Journal of Health Sciences.* 2021;3(2):30-37.
4. *Sadio AJ, Gbeasor-Komlanvi FA, Konu RY, Bakoubayi AW, Tchankoni MK, Bitty-Anderson AM,* et al. Assessment of self-medication practices in the context of the COVID-19 outbreak in Togo. *BMC Public Health,* 2021;21(1):1-9. <https://doi.org/10.1186/s12889-020-10145-1>.
5. *Nasir M, Chowdhury ASMS, Zahan T.* Self-medication during COVID-19 outbreak: a cross sectional online

- survey in Dhaka city. *Int J Basic Clin Pharmacol*. 2020;9(9):1325-1330. <https://doi.org/10.18203/2319-2003.ijbcp20203522>.
6. *Onchonga D, Omwoyo J, Nyamamba D*. Assessing the prevalence of self-medication among healthcare workers before and during the 2019 SARS-CoV-2 (COVID-19) pandemic in Kenya. *Saudi Pharm J*. 2020;28(10):1149–54. <https://doi.org/10.1016/j.jsps.2020.08.003>.
 7. *Bardou-Boisnier S, Caillaud K*. Les dispositifs informationnels sur les compléments alimentaires : une affaire de sante publique. *Questions de Communication*. [Information systems for food supplements: a matter of public health. *Communication Issues*]. 2015;(27):79-104. <https://doi.org/10.4000/questionsdecommunication.9705>.
 8. *Ronis MJJ, Pedersen KB, Watt J*. Adverse Effects of Nutraceuticals and Dietary Supplements. *An Rev Pharmacol Toxicol*. 2018;58:583–601. <https://doi.org/10.1146/annurev-pharmtox.2018.58.583>.
 9. *Jamal FZ*. La consommation des compléments alimentaires au Maroc (2015). [The consumption of food supplements in Morocco (2015)]. Mohamed V University, Faculty of Medicine and Pharmacy. Doctoral dissertation. 2016.
 10. *Dubecq C, Daniel Y, Aigle L, Bigard X*. Utilisation des compléments alimentaires à visée ergogénique chez les militaires français : Prévalence et modes de consommation lors d'une opération extérieure. [Use of ergogenic food supplements in the French military: Prevalence and consumption patterns during an external operation]. *Sci Sports* 2014;29(4):188–95. <https://doi.org/10.1016/j.scispo.2014.06.001>.
 11. *Lacerda FMM, Carvalho WRG, Hortegal EV, Cabral NAL, Veloso HJF*. Factors associated with dietary supplement use by people who exercise at gyms. *Rev Saude Publica*. 2015;49(63). <https://doi.org/10.1590/S0034-8910.2015049005912>
 12. *Naqvi AA, Ahmad R, Zehra F, Yousuf R, Kachela B, Nehal Nadir M*. Dietary Supplement Use Among Students of Pharmacy Colleges in the City of Karachi, Pakistan: Prevalence, Opinions, and Attitudes. *J Diet Suppl*. 2019;16(2):166–78. <https://doi.org/10.1080/19390211.2018.1443191>.
 13. *Pouchieu C, Deschasaux M, Hercberg S, Druesne-Pecollo N, Latino-Martel P, Touvier M, et al*. Comportements alimentaires des patients atteints de cancer ou en rémission dans la cohorte NutriNet-Santé: focus sur la prise de compléments alimentaires. [Dietary behaviours of patients with cancer or in remission in the NutriNet-Santé cohort: focus on dietary supplementation]. In: *Colloque Nutrition, microbiote, métabolisme et cancer NACRe*. 2015.
 14. *Hébuterne X, Gerber M*. La journée de réflexion sur les compléments alimentaires. *Nutrition Clinique et Métabolisme*. [The Food Supplement Retreat. *Clinical Nutrition and Metabolism*]. 2009;2(23):47–8. <https://doi.org/10.1016/J.NUPAR.2009.04.002>.
 15. *Tsui B, Dennehy CE, Tsourounis C*. A survey of dietary supplement use during pregnancy at an academic medical center. *Am J Obstet Gynecol*. 2001;185(2):433–7. <https://doi.org/10.1067/mob.2001.116688>.
 16. *Mestaghanmi H, Labriji A, Kehailou FZ, Sabri A, Barka CA, Bouzoubaa H, et al*. Study of the Association between the Consumption of Dietary Supplements and Lifestyle Factors in a Population of Moroccan Academics during the COVID-19 Health Crisis. *OAlib*. 2021;8(6):1-30. <https://doi.org/10.4236/oalib.1107585>.
 17. *Nakhal SA, Domiati SA, Amin MEK, El-Lakany AM*. Assessment of pharmacy students' knowledge, attitude, and practice toward herbal dietary supplements. *Journal of American College Health*. 2022;70(6):1826-1830. <https://doi.org/10.1080/07448481.2020.1825226>.
 18. *Delimaris I*. Adverse effects associated with protein intake above the recommended dietary allowance for adults. *ISRN Nutr*. 2013;2013:126929. doi: 10.5402/2013/126929
 19. *Rutkowski M, Grzegorzcyk K*. Adverse effects of antioxidative vitamins. *Int. J. Occup Med Environ Health*. 2012;25(2):105-12.

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