

Vegetarianism in Food-Based Dietary Guidelines

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ABSTRACT

Plant foods are staples of many cultures in the world. Conversely, the appearance of vegetarianism in Western countries is a relatively recent phenomenon, showing an upward trend: people following vegetarian diets (both lacto-ovo-vegetarian-LOV and vegan-VEG), account today for about 10% of the Western population. According to the principle of non-discrimination, the most recent national dietary guidelines for the general population (DGLs) of some Western countries have adapted their contents to comprise vegetarian eating patterns. Moreover, since 1997, specific vegetarian food guidelines (VFGs) were developed.

The aim of this review was to summarize and compare the information and recommendations of the food-based dietary guidelines (FBDGs) contained in the DGLs usable by vegetarians, and in the main VFGs; to extract a list of basic criteria for the planning of a well-balanced vegetarian diet, and to identify the most valid FBDG for vegetarians.

An Internet search was conducted in the English language, in order to identify national DGLs applicable to vegetarian dietary patterns, and international VFGs. Four Western DGLs and six VFGs were selected.

Compared to the majority of DGLs, VFGs are not an "adaptation" of omnivorous (OMN) eating patterns to vegetarian ones, but rather devoted guides: they include only foods consumed by vegetarians, and take into account their specific nutritional needs. VFGs offer qualified advice to meet the most updated standards of adequacy and safety of the diet: the varied consumption of all plant foods, mainly unprocessed; the respect of individual's calorie requirements; the optional addition of small amounts of foods of animal origin (dairy/eggs); the attention towards some potentially critical nutrients. According to this criteria, the VFG for North American Vegetarians can represent the most accurate and practical model: not only is it consistent with research on the adequacy of vegetarian diets, but it is applicable both to LOV and VEG eating patterns and to all lifecycle stages beyond 4 years of age.

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Introduction

In 2011, the International Council of the International Vegetarian Union (IVU) defined vegetarianism *as a diet of foods derived from plants, with or without eggs, dairy products, and/or honey*¹. So, vegetarian diets rely on grains, vegetables, fruits, legumes, nuts and seeds, excluding all kinds of animal flesh from the diet; some vegetarians even exclude food products obtained from living animals. Therefore, on the basis of the presence or absence of eggs, dairy foods and honey, it is possible to distinguish two main vegetarian eating patterns:

Lacto-ovo-vegetarianism (LOV) (including every kind of plant foods, dairy foods and eggs, but excluding meat, fowl, and salt- and fresh-water animal foods), which can be further divided into lacto-vegetarianism (including dairy products, but excluding eggs) and ovo-vegetarianism (including eggs, but excluding dairy foods).

Veganism (VEG) (including every kind of plant foods, but excluding meat, fowl, salt- and fresh-water animal foods, dairy products, eggs and honey).

In this paper, the term "vegetarianism" will not be used as synonymous of LOV.

Other types of vegetarian eating patterns also exist, such as the raw, fruitarian, hygienist and macrobiotic patterns. They are less common and more restrictive than the above two main patterns described above, as they may limit or exclude one or more plant food groups; moreover, some do not always exclude

flesh. Therefore, they can not represent a good model for a well-balanced vegetarian diet.

Large cohort studies performed on Western vegetarians show a protective effect of vegetarianism on cardiovascular disease^{2,3}, type 2 diabetes^{4,5}, body weight control⁵⁻⁷, metabolic syndrome⁸, blood pressure levels^{3,9,10}, serum lipid levels^{3,11}, diverticular disease¹², cataracts¹³, and overall and some site specific cancers¹⁴⁻¹⁶. Similarly, the results of clinical intervention trials support the effectiveness of vegetarian diets in the management of metabolic diseases and in the control of cardiovascular risk factors¹⁷⁻²².

According to the *American Dietetic Association* (ADA), compared to non-vegetarian diets, vegetarian diets are associated with lower intakes of saturated fat and cholesterol and higher intakes of fiber, magnesium and potassium, vitamins C and E, folate, carotenoids, flavonoids, and other phytochemicals, which can be responsible for some of the health advantages of vegetarian diets. However, vitamin B12, calcium, vitamin D, zinc, and long-chain omega-3 fatty acid intakes could be lower in some vegetarian subjects²³. All vegetarians can be at risk of an inadequate vitamin B12 nutritional status^{24,25}, and VEGs calcium intakes can range from 500 to 940 mg/daily^{26,27}. Alpha linolenic acid (ALA) intakes and blood levels vary among the different studies on vegetarians, but all studies report low intakes and low blood levels of omega-3 long-chain polyunsaturated fatty acid²⁸⁻³². Vitamin D deficiency represents instead a worldwide problem³³: it is not associated with vegetarian

status, but with the degree of skin pigmentation, sun exposure and supplementation³⁴.

Conversely, protein requirements can be met from a varied consumption of plant foods, if energy intakes are adequate^{23,35}. Average iron status is also adequate in vegetarians, whose iron stores are normal, even if lower than in omnivorous (OMN) subjects^{36,37}. Zinc intakes vary among studies on Western vegetarians, but overt zinc deficiency has never been reported^{23,26}.

Both major vegetarian eating patterns may vary considerably in their dietary and nutritional composition. In the LOV pattern, this depends on the extent to which dairy products, eggs and their derivatives are consumed. For both patterns, this depends on the type and amount of plant foods consumed, and on their degree of processing. Thus, food guidelines may represent a tool for planning balanced LOV or VEG meals for all stages of the life cycle, to satisfy requirements for critical nutrients and to promote optimal nutrition for health status and disease prevention.

The World Health Organization (WHO) states that food-based dietary guidelines (FBDG) should be *“the expression of the principles of nutrition education mostly as foods; intended for use by individual members of the general public, and, if not expressed entirely as foods, written in language that avoids, as far as possible, the technical terms of nutritional science”*³⁸. To this end, FBDG theoretical bases are translated in a framework providing practical information and advice, applicable to one or more eating patterns. The information is

proposed mainly in terms of foods, and is eventually converted in a visual form, offering a graphic representation, which is more commonly pyramid or plate-shaped. Typically, an FBDG proposes some food groups formed by foods with similar nutritional characteristics, and suggests the relative amount of food, as number of “servings”, to be consumed from each group, when planning meals or daily menus.

National dietary guidelines (DGLs) are released by government agencies, and each developed country periodically publishes its updated DGLs, which are meant to educate people to adopt healthy lifestyles. So, even if DGLs consider also other health affecting factors (i.e. physical activity), they deal mostly with FBDGs, to help people to make informed food choices, compliant with science-based nutritional recommendations. Since they are addressed to the general population, their contents take into account the customs and dietary trends of their citizens, in the native language.

While plant food are staples of many cultures in the world, the appearance of vegetarianism in Western countries is a relatively recent phenomenon. The shift of individual dietary habits towards vegetarianism shows an upward trend. Today, people following a vegetarian diet in Western countries account up to 10% of the total population^{39,40}: so, in order to respect citizen’s individual choices, vegetarianism should also be taken into account when a government develops its DGLs.

National DGLs of some Western countries recently included information on vegetarian eating patterns in

their FBDGs. For example, USA DGLs include information for LOV and VEG eating patterns. Scientific societies and research centres also released food guides specifically developed for LOVs and VEGs (vegetarian food guides - VFGs). The two situations will be dealt with, referring to key documents.

Aim and Methods

Aim

Aim of this review is to summarize the main features of the different FBDGs (DGLs and VFGs) usable by vegetarians of Western countries; to compare their recommendations regarding some potentially critical nutrients; to generate a list of specific recommendations, reflecting research data on the nutritional adequacy and health implications of vegetarian dietary models; eventually, to identify the most valid FBDG for vegetarians.

Selection Criteria

The selection of the FBDGs, which will be discussed in this review, was performed as follows:

DGLs

Background: to be used not only by OMNs, but also by VEG and LOV individuals, a DGL should include the following characteristics:

- plant and animal protein foods should form a single food group, and indications regarding the amount of food to be consumed should not distinguish between the two different sources of protein;
- the dairy food group, if present, should also include

non-dairy alternatives.

Selection: according to these criteria, we performed a specific Internet search for each Western nation, looking for DGLs in the English language by using the key words "*dietary guidelines*". The search led to obtain four DGLs, fully compliant with the above characteristics, released by the following countries: Canada⁴¹, Australia⁴², USA⁴³, and UK⁴⁴.

VFGs

Background: many VFGs are available on the web, but the majority has not been peer-reviewed. We did not take into account VFGs, which were not selected by the search engines we used.

Selection: we performed a search on *PubMed* and *Google Scholar*, using, as keywords, "*vegetarian food guide/guidelines*" and "*vegan food guide/guidelines*": this led us to identify six VFGs. Four were applicable to LOV and VEG eating patterns, released by: Loma Linda University (CA, USA)⁴⁵⁻⁴⁷, American Dietetic Association⁴⁸, Dietitians of Canada⁴⁹, Scientific Society of Vegetarian Nutrition-SSNV (Italy)⁵⁰. One resulted applicable only to LOV eating patterns (Japanese Vegetarian Food Guide) (Japan)⁵¹. We rejected the sixth, a USA VFG released in 2002 by the Arizona Department of Nutrition⁵², as we considered that the 2003 USA VFG⁴⁸ represented a more updated and relevant guide.

Finally, some peer-reviewed publications on vegan diets present in the search list, authored by the *Physician Committee for Responsible Medicine-PCRM* (USA), lead us to identify one more VFG, the *PCRM Power Plate*⁵³,

applicable only to VEG patterns.

Data evaluation

The structure and content of each FBDG were carefully examined. For both categories, we summarized the main characteristics (food groups, resources for vegetarians in the DGLs, applicability to lifecycle stages) in Table 1 (for DGLs) and Table 2 (for VFGs), and compared the respective recommendations regarding some nutrients to focus on, in Table 3.

Vegetarianism in Dietary Guidelines (Dgls): The International Panorama

The DGLs of the countries which included in recent years recommendations for vegetarians, propose a very similar food distribution in the food groups: three plant-food groups (grains, vegetables and fruits), one group of protein foods (containing both plant and animal protein foods: legumes, nuts and seeds, soy and wheat, meat and eggs), the dairy group (including also the calcium-fortified non-dairy alternatives). This setting is used in the Canadian DGLs, edited by Health Canada⁴¹, in the Australian DGLs, edited by the National Health and Medical Research Council⁴², in the USA DGLs, edited by the US Department of Agriculture and Department of Health and Human Services⁴³, and in those published by the British (UK) National Health Service⁴⁴. In the latter, fruits and vegetables form one group, so that they offer only four main groups (a 5th small group is formed by food and drinks rich in fats and sugars which, in the other guides, are placed outside the diagram) (Table 1).

Canadian⁵⁴⁻⁵⁷ and Australian⁵⁸⁻⁶⁰ DGLs also offer information for different ages and life stages, but the attention given to vegetarian diets simply consists in providing the respective vegetarian alternatives in the groups of protein and dairy foods, and the recommendation for VEG individuals -in the Australian DGLs- to include a vitamin B12 source⁶¹ (Table 3). On the contrary, USA and British DGLs propose some sections specifically developed for vegetarian people, at different ages and life stages.

USA Dietary Guidelines

In comparison with a 2006 national poll, reporting that 3.7% of Americans identified themselves as vegetarian (2.3%) or vegan (1.4%)⁶², the prevalent figures for vegetarianism in USA are rapidly raising: a new 2013 poll reports that 13% of Americans identify themselves as vegetarian (6%) or vegan (7%)³⁹. Consequently, the 2010 *Dietary Guidelines for Healthy Americans* include vegetarian alternatives in the protein and dairy food groups and provide specific recommendations for vegetarians⁶³, highlighting the favorable health outcomes resulting from prospective studies on vegetarian adults, compared to non-vegetarians (regarding obesity, cardiovascular disease and total mortality), and from intervention studies with vegetarian diets (regarding hypertension).

Information on vegetarian diets are provided in the report (pp. 45 and 52, and appendices 8 and 9) and in *MyPlate* website and its related resources^{35,64,65}.

Table 1: Summary of the characteristics and applicability to LOV and VEG eating patterns of the DGLs.

COUNTRY	Canada	Australia	USA	UK
Dietary patterns	OMN	OMN	OMN/DASH/LOV/VEG	OMN/LOV/VEG
FOOD GROUPS	Grains	Grains	Grains	Grains
	Vegetables and Fruits	Vegetables Fruits	Vegetables Fruits	Vegetables and Fruits
	Protein foods (legumes, nuts and seeds, soy and wheat, meat and eggs)	Protein foods (legumes, nuts and seeds, soy and wheat, meat and eggs)	Protein foods (legumes, nuts and seeds, soy and wheat, meat and eggs)	Protein foods (legumes, nuts and seeds, soy and wheat, meat and eggs)
	Dairy foods (including calcium-fortified non-dairy alternatives)	Dairy foods (including calcium-fortified non-dairy alternatives)	Dairy foods (including calcium-fortified non-dairy alternatives)	Dairy foods (including calcium-fortified non-dairy alternatives)
	Fats outside the rainbow	Fats and sweets outside the plate	Calories from <i>SoFAS</i> * outside the plate	Food/drinks rich in fats and sugars
Resources for vegetarians	Vegetarian alternatives in the meal planning examples for the protein foods and dairy groups.	Vegetarian alternatives in the meal planning examples for the protein foods and dairy groups.	Meal planning examples for LOVs (changes in the protein foods group, Appendix 8) and VEGs (changes in the protein foods and in the dairy groups, Appendix 9).	Vegetarian alternatives in the protein foods and dairy groups, plus distinct sections for LOVs and VEGs. Links to the resources provided by the UK Vegetarian Society and the UK Vegan Society.
Lifecycle stages	Distinct sections for adults, pregnancy, lactation and childhood, with meal planning examples including size and amounts of servings for each food group, including vegetarian alternatives.	Distinct sections for adults, pregnancy and childhood, with meal planning examples including size and amounts of servings for each food group, including vegetarian alternatives.	Advice for pregnancy, lactation and childhood, older adults, with information on food choices and critical nutrients, also for vegetarians.	Distinct sections for LOV and VEG pregnancy, lactation and childhood, with information on food choices and critical nutrients.

*SoFAS (Solid Fats and Added Sugars)

Table 2: Summary of the characteristics of the different VFGs.

	INSTITUTION/ORGANIZATION				
	LLU	ADA/DoC	JVF	SSNV	PCRM
Dietary patterns	LOV/VEG	LOV/VEG	LOV	LOV/VEG	VEG
Intake of energy considered for the dietary models (kcal)	1600-2500	1400-1500	2000	1600-3000	Not provided
LIFECYCLE STAGES	Not specified	Adults, Children >4y, Adolescents, Pregnant and lactating women	Adults	Adults	Adults
FOOD GROUPS					
Grains	Yes	Yes	Yes	Yes	Yes
Vegetables	Yes	Yes	Yes	Yes	Yes
Fruits	Yes	Yes	Yes	Yes	Yes
Legumes	Yes	In the protein food group	In the protein food group	In the protein food group	Yes
Dairy foods *(including calcium-fortified non-dairy alternatives)	Yes	In the protein food group *	Yes	In the protein food group *	Absent
Eggs	Yes	In the protein food group	In the protein food group	In the protein food group	Absent
Nuts and seeds	Yes	In the protein food group and the fat food group	In the protein food group	In the protein food group and the fat food group	Yes
Vegetable oils	Yes	In the fat food group	In the fats, sugar and seasonings group	In the fat food group	Absent
Sweets	Yes	Not as one group	In the fats, sugar and seasonings group	Not as one group	Absent
Protein foods (legumes, seeds and nuts, soy and wheat, meat and eggs)	Not as one group	Yes	Yes	Yes	Not as one group
Fat foods	Not as one group	Yes	In the fats, sugar and seasonings group	Yes	Absent
Calcium-rich-foods	Not as one group	Yes	Not as one group	Yes	Not as one group
Discretionary calories	Not as one group	Not as one group	Not as one group	Yes	Absent
Fats, sugar and seasonings	Not as one group	Not as one group	Yes	Not as one group	Absent

Table 3: Nutrients to focus on in DGLs and VFGs (for LOVs and VEGs adults)

NUTRIENTS	DGL				VFG				
	Canada	Australia	USA	UK	LLU	ADA/DoC	JVF	SSNV	PCRM
Calcium	no	no	yes	yes (only for VEGs)	no	yes	no	yes	no
Vitamin D	no	no	yes	yes (only for VEGs)	yes	yes	no	yes	no
Vitamin B12	no	yes (only for VEGs)	yes	yes	yes (only for VEGs)	yes	no	yes	yes
Omega-3 fats	no	no	No	yes	yes	yes	no	yes	yes
Iron	no	no	yes	yes	no	no	no	no	no
Protein	no	no	yes	no	no	no	no	no	no
Zinc	no	no	yes	no	no	no	no	no	no

(no=no emphasis or specific recommendations for the nutrient are present in the guide: it is considered that its needs can be met by the varied intake of adequate amounts of all food groups; yes=emphasis or specific recommendations for the nutrient are present in the guide)

USA DGLs state that vegetarian diets can meet all the recommendations for nutrients: the key is to consume a variety of foods in amounts adequate to satisfy the individual calorie requirements. The main sources of nutrients for vegetarians are foods available in the five main food groups of *MyPlate* (Table 1, Figure 1), which should all be consumed on a daily basis, varying the choices of foods belonging to the same group. Recommendations on critical nutrients for the general population (*Foods and Nutrients to Increase*) relate to fiber, folic acid, potassium, calcium and vitamin D, and iron, while recommendations on vitamin B12 are specific for all people over-50 years of age, and for VEGs. Since vegetarian diets are abundant in fiber, folic acid and potassium, nutrients that vegetarians may need to focus on are summarized in Table 3: unlike British DGLs and

all VFGs, attention towards zinc and protein intakes is stressed for vegetarians; a recommendation for omega-3 fatty acid intake is missing.

Appendices 8 and 9 propose, respectively, LOV and VEG adaptations of the USA OMN eating patterns, providing the suggested distribution and amount of food to be consumed, for calorie requirements from 1000 to 3200 kcal. They are intended for healthy Americans aged 2 years and older. The proposed patterns from 1000 to 1400 kcal are intended for children from 2 to 8 years of age, and those from 1600 to 3200 kcal for children from 9 years through adulthood (for children aged 4-8 years requiring more energy, the patterns from 1600 kcal and above should limit the dairy group servings to the amounts of the 1400 kcal pattern). An amount of free calories, which can be optionally consumed in form of

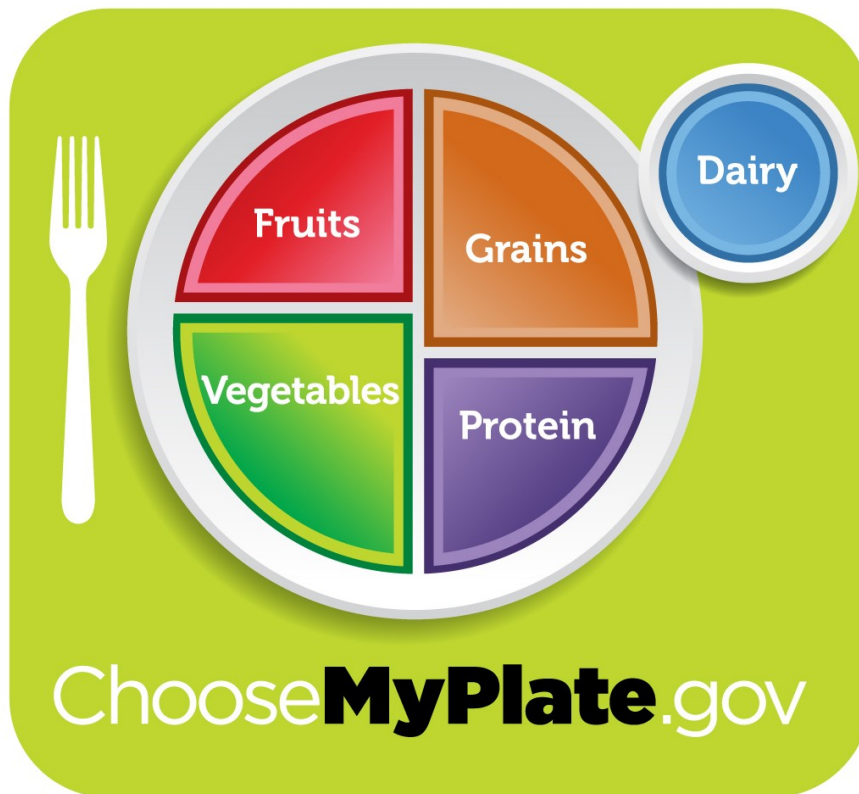


Fig. 1: MyPlate

Available at: http://en.wikipedia.org/wiki/File:USDA_MyPlate_green.jpg
(Accessed Aug 14, 2014; imagine in the public domain)

SoFAS (from "Solid Fats and Added Sugars"), is also indicated.

All patterns are proposed as healthy, so both OMN and LOV are largely based on plant foods, sharing with the VEG pattern a major overlapping area composed of plant foods (about 81% by weight)⁶⁶. The nutritional adequacy of the three patterns was proved⁶⁷⁻⁷⁰, and the total environmental impact analyzed by life cycle assessment (LCA) was the lowest (35% and 22% of that of the LOV and OMN patterns, respectively) for the VEG pattern, mainly due to the absence of animal foods⁶⁶.

British (UK) Dietary Guidelines

According to a poll carried out in 2014, the prevalence of vegetarians in UK, the birthplace of vegetarianism in Western cultures, is similar to that in the USA: as high as 12%, with the figures rising to 20% among people aged 16-24. Although not providing the relative figures for vegetarians and vegans, the report estimates that the UK meat-free food market is sharply increasing⁴⁰.

British DGLs⁴⁴ include a very detailed section for vegetarians⁷¹, basically in accordance with the more specific VFGs, and provide links to other resources edited by the UK Vegetarian and Vegan Societies^{72,73}.

The *Eatwell Plate* is composed of four main slices (33%

starchy foods, 33% vegetables and fruits, 12% protein foods, 15% dairy products and their non-dairy alternatives) and includes a small slice of fatty and sugary foods (corresponding to the USA DGLs *SoFAS* calories)⁷⁴. Recommendations for vegetarians are distinct for VEGs⁷⁵ and LOVs⁷⁶, and include specific information for the different lifecycle stages (pregnancy, lactation⁷⁷ and childhood⁷⁸) (Table 1). Information to meet the requirements of critical nutrients for LOVs and VEGs is included (Table 3). These recommendations reflect the content of USA and Canadian VFGs^{48,49}.

Food Guides for Vegetarian Nutrition

Far back in 1988, the *American Dietetic Association* (ADA, actually renamed the *Academy of Nutrition and Dietetics*) released its first position statement on vegetarian diets⁷⁹. Since then, this statement is periodically reconfirmed on the basis of the updates available from research on vegetarian nutrition. The most recent ADA's *Position Paper on Vegetarian Diets*, delivered in 2009, states that appropriately planned vegetarian diets (including total vegetarian or vegan diets), are "healthful, nutritionally adequate, may provide health benefits in the prevention and treatment of certain diseases", and that they are "appropriate for individuals during all stages of the lifecycle"²³.

Since only in recent times DGLs of some countries have included sections for vegetarians, about 20 years ago some prominent scientists in the field of vegetarian nutrition agreed upon developing a food guide for

vegetarians; later, some scientific societies and organizations developed other VFGs.

Foods consumed by vegetarians are placed in food groups that can be different in the various VFGs, as shown in Table 2. However, all VFGs were developed by professionals with long-standing expertise in vegetarian nutrition: for this reason, their recommendations may be more reliable than those provided by the DGLs discussed in the previous section.

Loma Linda University Vegetarian Food Pyramid (USA)

This was the first VFG in the world. In 1995, an international group of researchers in the field of vegetarian nutrition began to develop this VFG⁴⁵⁻⁴⁷. The process was completed in 1997, when this VFG was presented at the 3rd International Congress on Vegetarian Nutrition, organized by the University of Loma Linda, California (major research center in the field of vegetarian nutrition). Based on a few main principles, resulting from consensus among researchers and summarized in Table 4, this first VFG was "designed to reflect healthy patterns of dietary intake that are not only adequate but promote optimal health"⁴⁷.

Translated into a pyramid-shaped diagram, these recommendations can be adopted both by LOVs and VEGs, as they propose five groups of plant foods at the bottom of the pyramid, representing the *core* of any healthy vegetarian diet, and four groups at the top of the pyramid, considered optional, unnecessary for the nutritional adequacy of the diet (Figure 2 and Table 2).

Table 4 : First basic Principles of a Healthy Vegetarian Diet⁴⁷

FIRST BASIC PRINCIPLES OF A HEALTHY VEGETARIAN DIET
1. Consume a variety and abundance of plant foods.
2. Primarily consume unrefined, minimally processed plant foods.
3. Consumption of dairy products and/or eggs is optional.
4. Consuming of a wide range of fat from plants is compatible with health.
5. Consume generous amounts of water and other fluids.
6. Pay attention to other healthy lifestyle factors.

This VFG recommends also the attention toward potentially critical nutrients, as listed in Table 3, regular physical activity and the abundant consumption of water and fluids. The process leading to the development of this first VFG has been accurately described^{45,46}. Its updated version, released in 2008, is shown in Figure 3⁸⁰.

The Adventist cohort, recruited in North America for the studies on the Adventist's Mortality and Health, largely adopts this VFG, and its favorable health outcomes were recently reported in a cumulative analysis⁸¹. The environmental impact of the diet was also addressed: the average greenhouse gases emissions per year, assessed in a large sample of participants of the

Adventist Health Study 2, were 29% lower for vegetarians, compared to non-vegetarians⁸².

Vegetarian Pyramid of the American Dietetic Association (ADA) and Vegetarian Rainbow of the Dietitians of Canada (DoC)

In 2003, American Dietetic Association (ADA) in collaboration with Dietitians of Canada (DoC), updated its position statement on vegetarian diets⁸³. A complementary *New Food Guide for North American Vegetarians*^{48,49} was edited by a team of nutritionists with expertise in vegetarian nutrition: it contains practical information and recommendations to plan vegetarian diets for adults, pregnant and lactating women, children over 4 years and adolescents.

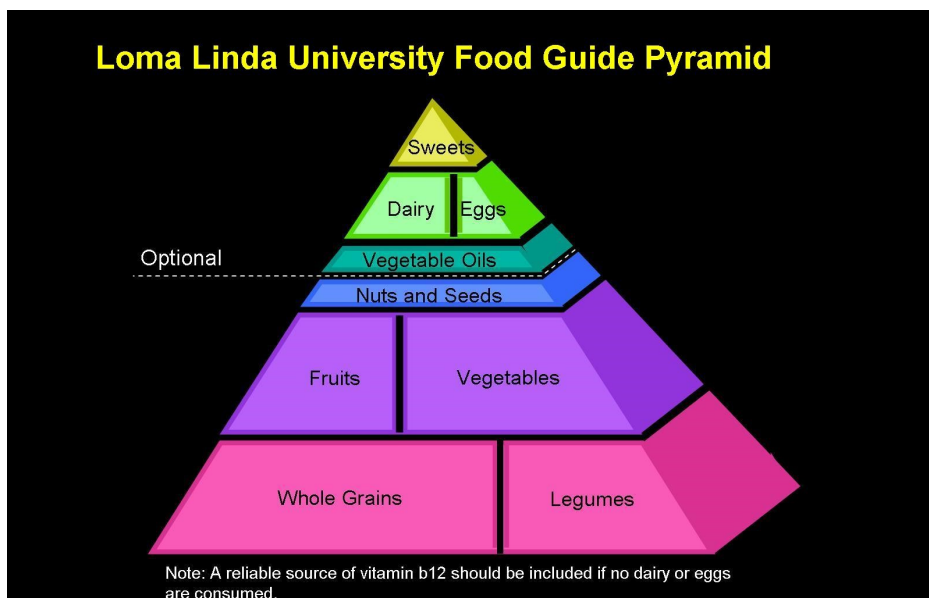


Fig 2: The first Vegetarian Food Pyramid

(©1997 Loma Linda University, School of Public Health, Department of Nutrition).

Available at: www.vegetariannutrition.org/3ICV N%20Pyramid.jpg

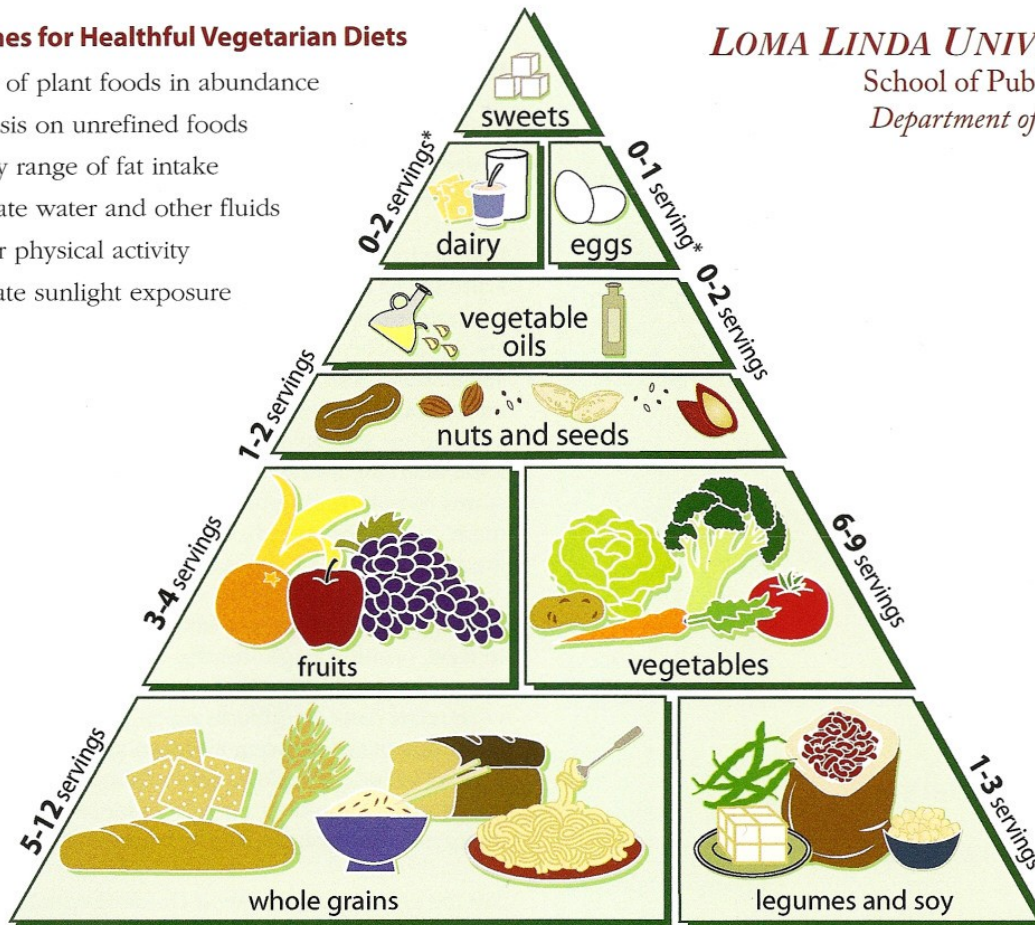
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The Vegetarian Food Pyramid

Guidelines for Healthful Vegetarian Diets

- Variety of plant foods in abundance
- Emphasis on unrefined foods
- Healthy range of fat intake
- Adequate water and other fluids
- Regular physical activity
- Moderate sunlight exposure

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* A reliable source of vitamin B12 should be included if no dairy or eggs are consumed.

Other Lifestyle Recommendations



Daily Exercise



Water—eight, 8 oz. glasses per day



Sunlight—10 minutes a day to activate vitamin D

Calories/day ▶	1600kcal/day	2000kcal/day	2500kcal/day	1600kcal/day	2000kcal/day	2500kcal/day
Food Groups	vegan servings/day			lacto-ovo servings/day		
Whole Grains	5	7	12	5	6	9
Legumes and Soy	3	3	3	3	3	3
Vegetables	6	8	9	6	8	9
Fruits	3	4	4	3	4	4
Nuts and Seeds	2	2	2	1	1	2
Vegetable Oils	1	2	2	1	2	2
Dairy Products	0	0	0	2	2	2
Eggs	0	0	0	1/2 egg	1/2 egg	1/2 egg
Sweets	Optional					

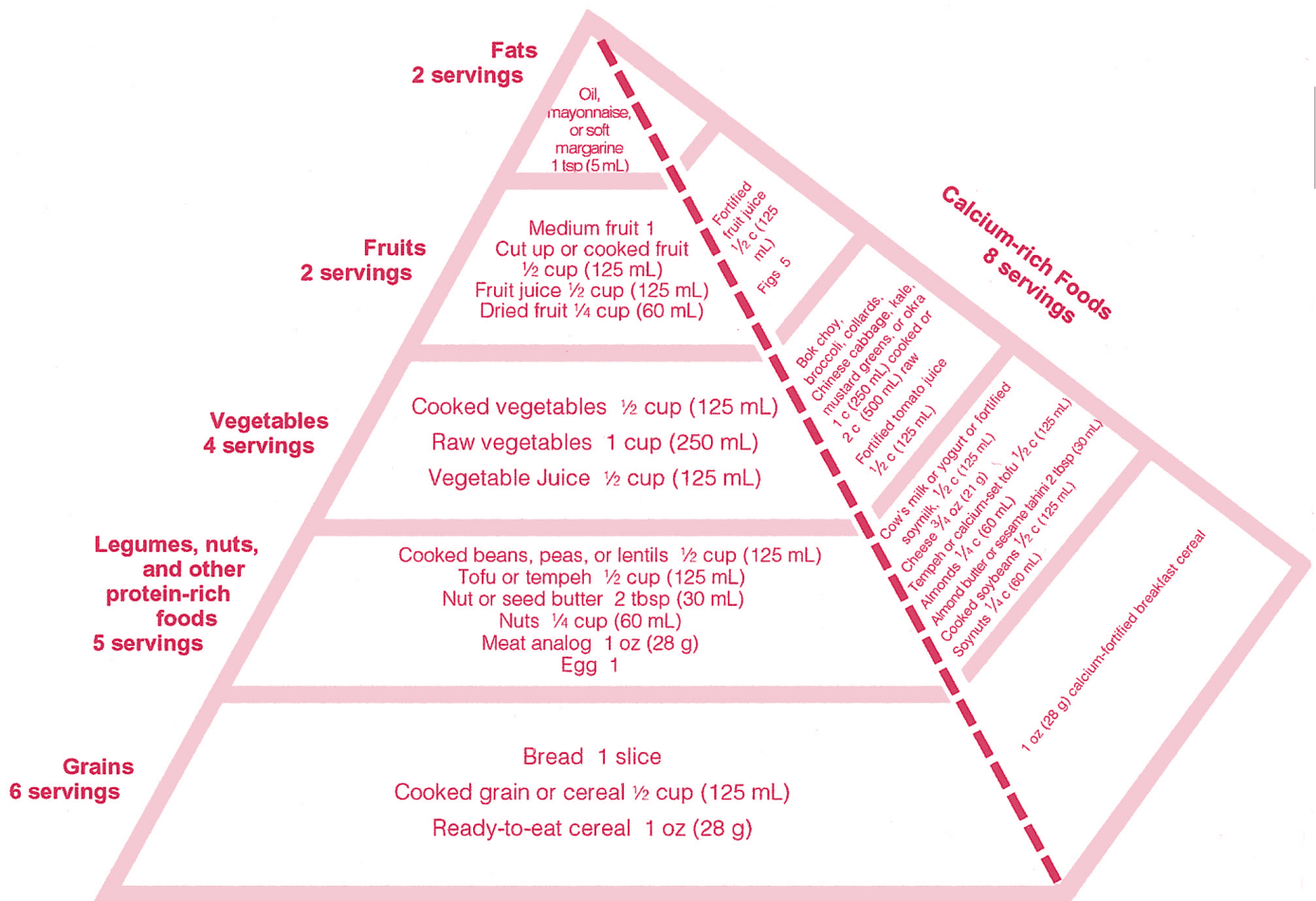
LOMA LINDA UNIVERSITY • SCHOOL OF PUBLIC HEALTH • DEPARTMENT OF NUTRITION
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Fig. 3: Updated Loma Linda Vegetarian Food Pyramid (©2008 Loma Linda University, School of Public Health, Department of Nutrition). Available at: www.vegetariannutrition.org/food-pyramid.pdf (Accessed Aug 14, 2014, reproduced with permission)

Formulated in the shape of a pyramid (USA, Figure 4) and a rainbow (Canada), it distributes food in 5 major groups (Table 2). A key peculiarity of this VFG is the creation of a 6th transverse group, collecting all calcium-rich foods from the other food groups. Therefore, the consumption of at least 8 servings of foods belonging to this group can allow meet calcium requirements, without focusing on dairy and non-dairy analogues. The *Special Considerations* emphasize the importance of consuming reliable sources of some critical nutrients (Table 3). It is stated that the requirements of protein, iron and other nutrients not included in the *Special Considerations* section, can be met by the varied consumption of foods belonging to all the food groups.

Japanese Vegetarian Food Guide

The Japanese VFG, released in 2009⁵¹, was developed on the basis of ADA recommendations^{23,48} and the *Japanese Food Guide Spinning Top*⁸⁴ for OMNs. Inspired by an asymmetric double-pointed pyramid, this VFG is composed of 6 food groups (Table 2). Conceived for adult Japanese LOVs, it includes typical Asian dishes in the protein group, but does not consider non-dairy alternatives, even if it proposes, for lactose intolerance, foods from other groups such as calcium sources (nuts and seeds, seaweeds and green leafy vegetables), in accordance with ADA/DoC VFG^{48,49}. No recommendation on critical nutrients is included (Table 3).



The nutritional composition of this VFG, developed with the contribution of some Japanese Adventist Hospitals and Loma Linda University, is reported as adequate⁵¹.

Veg Pyramid of the Scientific Society of Vegetarian Nutrition (SSNV-Italy)

The Italian VFG, proposed for adult vegetarians, was first delivered in 2005 and later further revised^{50,85,86}. Its principles are set out in a pyramid-shaped diagram, *VegPyramid* (Figure 5), whose components are (Table 2): a) the main food groups, which form the 5 bands of different colours and width of the main pyramid; b) the transverse group of calcium-rich foods, represented by the smaller pyramid inside the main one; c) the discretionary calories (corresponding to the USA DGLs *SoFAS* calories and the *Eatwell Plate* 5th slice),

represented by the grey strip at the basis of the pyramid. Information for optimizing the intakes of potentially critical nutrients are provided as *Particular Recommendations*, which are compliant with ADA/DoC VFG^{48,49} (Table 3). Its nutritional composition in macro- and micronutrients, for the calorie range 1600-3000 kcal, is reported as adequate⁵⁰.

Power Plate by Physician Committee for Responsible Medicine (PCRM-USA)

PCRM research group authored pioneering intervention studies with low-fat vegan diets in the management of diabetes mellitus, hypercholesterolemia, and obesity-overweight. Its VFG proposal, *Power Plate*⁵³ (Figure 6), excludes any form of added fat, as well as animal food, representing a model of low-fat vegan diet, which can

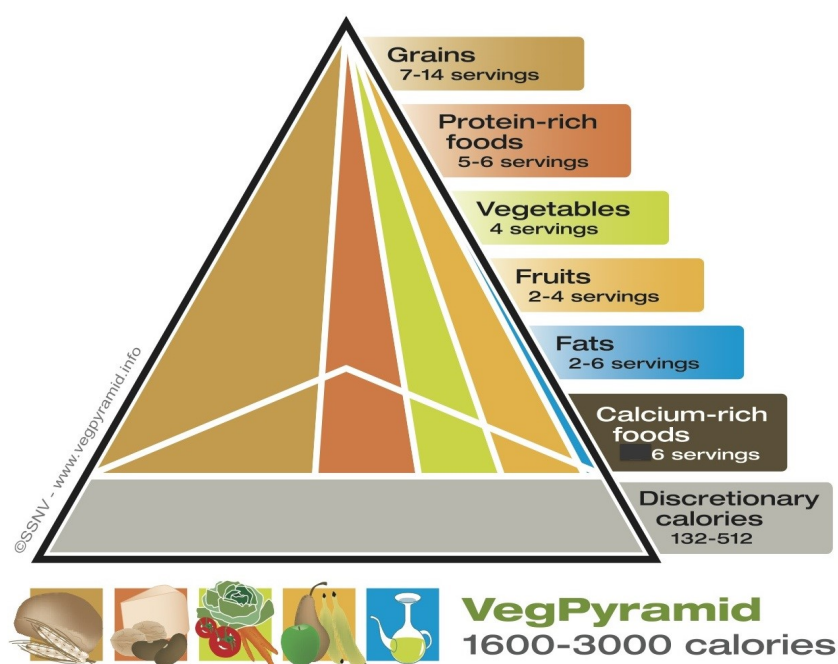


Fig. 5: VegPyramid
Available at: <http://www.vegpyramid.info>
(Accessed Aug 14, 2014; reproduced with permission)

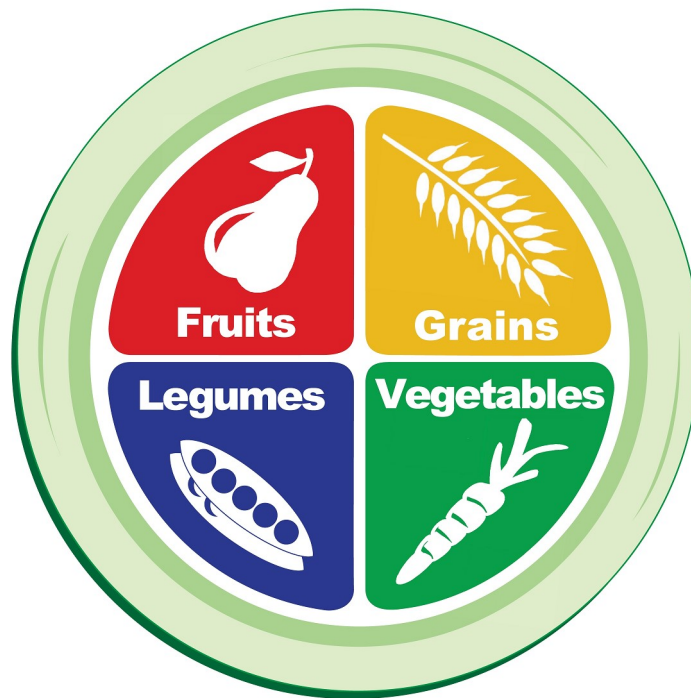


Fig. 6: Power Plate

Available at: <http://www.pcrm.org/images/health/pplate/PowerPlategraphichirez.JPG> (Accessed Aug 14, 2014; reproduced with permission)

be applicable also as therapeutic regimen. It includes only 4 groups of plant foods, recommends the consumption of a small amount of nuts and seeds (about 30g/d) (Table 2), and of a reliable source of vitamin B12 (Table 3).

Unlike other VFGs, *Power Plate* does not include information on the amount of foods to consume for each of the four groups, thus representing an extremely simple food guide. It states that any scientific basis for emphasizing one or more groups is lacking, and that the key message is to consume a variety of plant foods rather than focusing on specific food groups⁸⁷.

The nutritional composition of this VFG, promoting ad libitum consumption of plant foods without any added fats, was checked in clinical trials: it can meet or exceed the Dietary Reference Intakes, and provide a beneficial ratio of health protective-detrimental nutrients⁸⁸⁻⁹¹. Its acceptability was also assessed and resulted similar to that of other therapeutic regimens⁹²⁻⁹⁴.

Lessons for Vegetarianism

Attention toward vegetarian citizens has been shown in modern times by some Western governments, with the inclusion of specific sections and recommendations for vegetarians in their DGLs. However, since 1997, some VFGs are available. Their advantage is not to simply represent an "adaptation" of recommendations for

OMNs: VFGs are devoted to vegetarians, including only foods they consume. In addition to being easy to use, VFGs offer qualified advice to carry out well-planned vegetarian diets. This paragraph intends to propose a list of five items specific for vegetarians, summarized in Table 5: we believe that, taken all together, they may allow to plan vegetarian diets respecting the most modern standards of adequacy and safety. Any item, to be included in the list, was considered valuable if present in at least two VFGs. We did not consider an item as valuable, if present in DGLs but not in VFGs (as shown in Table 3). Two further items, reflecting other healthy lifestyle habits for everyone, complete the list.

1. Consume large amounts and variety of plant foods, emphasizing the intake of unrefined or minimally processed foods: almost all the FBDGs state that a vegetarian diet can be nutritionally adequate if it meets the calorie requirements from a varied selection of nutrient-dense foods, belonging to all the vegetarian food groups. This means that some types of restrictive diets, i.e., fruitarian one, can not provide adequate amounts of nutrients. Since many nutrient-dense foods are unprocessed, they should be emphasized in the diet, making it easier to meet nutrient requirements, including protein, iron and zinc.

2. Consumption of Dairy Products and/or Eggs is Optional: the inclusion of these foods is not considered necessary to guarantee the nutritional adequacy of a vegetarian diet, since the nutrients they provide (calcium, protein, and vitamin B12) can also be obtained

from other sources. They can be consumed in small amounts, if desired. Thus, the same FBDG can be used both by LOV and VEG people.

3. Choose Carefully and Limit Vegetable Fats, and Consume Good Sources of Omega-3 Fatty Acids:

the current recommendations on fat intakes state that the percentage of calories from fat should not exceed 35% of total calories. Complying with this limit means to prioritise foods with higher nutritional density, and limit excess calories. Vegetable fats should also be carefully chosen, avoiding *trans* fats and tropical oils (rich in saturated fats), limiting omega-6 fats, and emphasizing the consumption of monounsaturated oils and omega-3 fatty acids. The intake of omega-3 fatty acids from plant sources contributes to the adequacy of the diet, as research has shown that it can vary among vegetarians. This means to regularly consume small amounts of flaxseeds, flaxseed oil and walnuts.

4. Consume Adequate Amounts of Calcium and Pay Attention to vitamin D Status:

these are fundamental principles of any healthy diet. Research has shown that the intake of calcium can be low in vegan subjects; so, good calcium sources should be emphasized in the diet, by increasing the intakes of calcium-rich foods from plant sources. Conversely, as no kind of diet can provide adequate amounts of vitamin D, the recommendations for vitamin D are the same as for the general population.

5. Consume Adequate Amounts of Vitamin B12: the intake of reliable sources of vitamin B12, not only for

Table 5 : Modern basic principles of a healthy vegetarian diet (see text)

MODERN BASIC PRINCIPLES OF A HEALTHY VEGETARIAN DIET	
1.	Consume large amounts and variety of plant foods, emphasizing the intake of unrefined or minimally processed foods.
2.	The consumption of dairy products and/or eggs is optional.
3.	Choose carefully and limit vegetable fats, and consume good sources of omega-3 fatty acids.
4.	Consume adequate amounts of calcium and pay attention to vitamin D status.
5.	Consume adequate amounts of vitamin B12.
6.	Consume generous amounts of water and other fluids.
7.	Remember to pay attention to other healthy lifestyle factors.

VEGs but also for LOVs, is fundamental for a well-planned vegetarian diet, as vitamin B12 status can be compromised, over time, in vegetarian subjects who do not supplement it.

6. Consume Generous Amounts of Water and Other Fluids:

in every kind of diet, the intake of adequate amounts of fluids is obviously important. While vegetable beverages with added calcium, which may increase calcium dietary content, can be useful, empty-calorie fluids may be consumed using the amount of calories provided for this purpose.

7. Remember to Pay Attention to Other Healthy Lifestyle Factors:

this recognizes the importance of other lifestyle habits, primarily physical activity, but also the correction of risk behaviors such as smoking and the indiscriminate consumption of unnecessary substances.

Conclusion

The various FBDGs discussed in this paper offer important support to vegetarian people. The main principles underlying the recommendations are similar, but the resulting documents can be quite different, both

regarding the food group composition and, more relevant than ever, the potentially critical nutrients to focus on.

DGLs were developed for the general population, and try to meet vegetarian needs by providing vegetarian alternatives in the protein and dairy food groups.

While Canadian and Australian DGLs do not provide detailed, specific dietary recommendations for vegetarians, USA and British DGLs include devoted sections to this issue. Such information is not exactly the same, as the recommendations concerning the critical nutrients for vegetarians differ between the two DGLs (Table 3). While USA DGLs seem to adhere to a traditional concept of vegetarianism, more focused on the implications of "not eating" animal foods, and emphasize the need of nutrients which are, on the contrary, easily provided by plant foods (i.e. protein, iron), British DGLs show more consistency with research on the adequacy of vegetarian eating patterns, and contain information and advice fully in accordance with the recommendations proposed in some VFGs.

On the contrary, VFGs are conceived specifically for vegetarian people, and developed by nutritionists with expertise in vegetarian nutrition, i.e. in the knowledge of the nutritional composition of foods consumed by vegetarians, and of the deficiency-excess ratio risk. They represent a useful and simple tool for planning optimal vegetarian diets, offering not only information on the type and amount of food to consume, but also stressing the concept that the requirement of all nutrients should be always met, and suggesting how to do it.

It is important that an FBDG be conceived for use by both LOVs and VEGs. As the two eating patterns can turn one into the other in the same individual during his/her lifetime, it is recommended that one guide can be used for both dietary choices, and which can also provide information to satisfy the adequacy of the diet in the different lifecycle stages.

Every FBDG for vegetarians should reflect evidence resulting from research. Primarily, it should stress the importance of achieving individual calorie requirements, preferring unprocessed plant foods belonging to all food groups: all the FBDGs we reviewed in this paper agree that the adequacy of a vegetarian diet can be generally met by consumption of all the food groups included in the diagram. While the addition of small amounts of foods of animal origin (dairy/eggs) can represent an optional, individual choice, focusing on the intakes of potentially critical nutrients, according to lifecycle stage different requirements, is a recommendation that a

vegetarian FBDG should contain, as it should be a duty for every responsible vegetarian subject to adhere to.

According to these considerations, the most complete and accurate FBDG model for vegetarians is represented by the VFG for North American Vegetarians^{48,49}, which not only appears to be consistent with research on the adequacy of vegetarian diets, but is also the one usable by LOVs and VEGs in all lifecycle stages after 4 years of age. The first five items summarized in "*Lessons for vegetarianism*" are mainly in accordance with this FBDG.

Vegetarianism can be supported by different, often coexisting reasons: ethical, ecological and health-conscious. Whatever the reason, the health benefit of vegetarian diets can be a benefit for every individual following them. A comprehensive approach to vegetarian diets can be simplified by a FBDG, which can represent a reliable tool for professionals and individual subjects to conjugate ideals and health.

Conflict of Interest

Author has no conflict of interest.

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