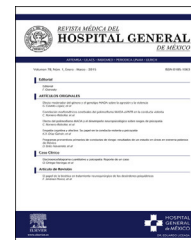




REVISTA MÉDICA DEL  
**HOSPITAL GENERAL**  
DE MÉXICO

[www.elsevier.es/hgmx](http://www.elsevier.es/hgmx)



REVIEW ARTICLE

## Dietary recommendations in patients with deficiency anaemia



A. Santoyo-Sánchez<sup>a,\*</sup>, J.A. Aponte-Castillo<sup>b</sup>, R.I. Parra-Peña<sup>c</sup>, C.O. Ramos-Peñafiel<sup>d</sup>

<sup>a</sup> *Unidad de Medicina Experimental, Facultad de Medicina, Universidad Nacional Autónoma de México, Mexico City, Mexico*

<sup>b</sup> *Universidad del Valle de México, Mexico City, Mexico*

<sup>c</sup> *Universidad Autónoma de Guadalajara, Guadalajara, Mexico*

<sup>d</sup> *Área de hospitalización, Servicio de Hematología, Hospital General de México "Dr. Eduardo Liceaga", Mexico City, Mexico*

Received 21 February 2015; accepted 11 June 2015

Available online 1 October 2015

### KEYWORDS

Diet;  
Anaemia;  
Iron;  
Folic acid;  
Vitamin B12

**Abstract** A diet deficient in iron, vitamin B9 (folic acid) and/or vitamin B12 (cobalamin) can affect erythropoiesis and cause anaemia. Treatment consists in the administration of supplements to compensate for dietary deficiencies and build up body reserves. Pharmacological treatment should be complemented by a diet designed to supply the micronutrients lacking in food. Patients should continue to follow the diet even after completing their therapy in order to prevent a recurrence of deficiency anaemia.

Nutritionists should understand deficiency anaemia, and physicians, particularly general practitioners, should be aware of dietary requirements. In this article, therefore, both health care professionals have come together to briefly explain, with examples, the type of diet that should be recommended to patients with deficiency anaemia.

© 2015 Sociedad Médica del Hospital General de México. Published by Masson Doyma México S.A. All rights reserved.

### PALABRAS CLAVE

Dieta;  
Anemia;  
Hierro;  
Ácido Fólico;  
Vitamina B12

### Recomendaciones nutricionales en pacientes con anemia carencial

**Resumen** Una dieta deficiente en hierro, vitamina B9 (folato) y/o vitamina B12 (cobalamina) ocasiona alteraciones en la eritropoyesis causando una anemia. El tratamiento se basa en administrar suplementos exógenos a fin de cubrir el déficit y restaurar las reservas corporales. Como complemento al manejo farmacológico debe diseñarse una dieta que facilite la disponibilidad de los micronutrientes en carencia en los alimentos durante el tratamiento y aun cuando éste termine, con la finalidad que el paciente conserve estos hábitos alimenticios y evite futuros eventos de anemia carencial.

\* Corresponding author at: Dr. Balmis 148, Col. Doctores, C.P. 06726 Mexico City, Mexico.  
E-mail address: [adr\\_blue\\_red@hotmail.com](mailto:adr_blue_red@hotmail.com) (A. Santoyo-Sánchez).

Los nutriólogos deben dominar el tema y no debe ser ajeno para los médicos, especialmente para el médico general, por lo cual el presente trabajo fue elaborado de forma conjunta por ambos profesionistas, a fin de servir al lector como una guía rápida con ejemplos concretos de dietas para este tipo de pacientes.

© 2015 Sociedad Médica del Hospital General de México. Publicado por Masson Doyma México S.A. Todos los derechos reservados.

## Introduction

Deficiency anaemias are a group of diseases caused by a diet lacking in the essential nutrients needed for erythropoiesis: iron, vitamin B12 and folic acid (vitamin B9).<sup>1</sup> These anaemias are usually found in malnourished elderly individuals, young people following weight loss regimens, and individuals in the low-income range, or with a comorbid condition (for example, incomplete dentition) that prevents them from following a healthy diet. It is also prevalent at certain stages in life, such as pregnancy, breast feeding, childhood and adolescence, when bodily nutritional requirements increase.<sup>2</sup>

Iron deficiency is the most common cause of anaemia worldwide, accounting for around 50% of all cases.<sup>3</sup> This is followed by megaloblastic anaemia caused by a diet deficient in B-group vitamins.<sup>2</sup>

The best and most sustainable strategy for preventing micronutrient deficiency is dietary improvement. Dietary changes can also act as a complement to pharmacological therapy, either by providing additional nutrients or by preventing adverse interactions between dietary supplements and food. Despite efforts to raise awareness of the need for dietary changes in these patients, most practitioners do not know which foods are really effective in correcting each type of anaemia.<sup>4</sup> This is further aggravated by widely held popular misconceptions or the out-dated scientific belief that iron-rich vegetables such as spinach or chard are good for anaemia, without considering the bioavailability of the inorganic (non-heme) iron in these vegetables and the limited capacity of the human digestive system to absorb it.<sup>5</sup> Sotelo et al. made a major contribution to this topic by analysing the vegetables most widely consumed in Mexico. The group found high concentrations not only of iron, but also of oxalate, tannins and phytates, which interact with iron and other proteins to form complexes that are hard to digest and prevent absorption.<sup>6</sup>

In the following paragraphs we will give a brief overview of nutritional recommendations for patients with deficiency anaemia.

### Iron deficiency

Iron is the second most abundant metal in the earth's crust. It is essential for life due to its role in nearly all redox reactions, and is a vital component in several bodily function, primarily haemoglobin synthesis and transport of oxygen throughout the body.<sup>7</sup>

A normal diet contains around 6 mg of iron for every 1000 calories. This gives a daily iron intake of between 13 and 20 mg, of which between 5% and 15% of iron in ferrous form is absorbed by the duodenum and upper jejunum (1–2 mg/day).<sup>8</sup>

Adult men and postmenopausal women need 8 mg of iron per day. Breast feeding mothers need 9 mg/day, or 10 mg/day in the case of an adolescent mother (14–18 years). Adolescent boys need at least 11 mg/day of iron. Adolescent girls need 15 mg/day; a requirement that increases to 18 mg/day in women aged over 18 years, and persists until they reach the menopause. Iron intake requirements reach a peak in pregnant women, both adolescent and adult, who need 27 mg/day. In all the foregoing cases, iron intake should never exceed 45 mg/day.<sup>9,10</sup>

Iron is present in the diet in 2 forms: heme (organic), of which 15–25% is absorbed, is commonly found in red meat, fish and poultry, and non-heme (inorganic), usually found in pulses, grains and fruit, of which only 5–20% is absorbed.<sup>9</sup> Table 1 shows the primary source of dietary iron.<sup>11</sup> Fig. 1 shows an example of a balanced diet capable of providing 26.1 mg/day of iron.

### Folic acid (vitamin B9) deficiency

Folic acid is mainly absorbed in the jejunum and ileum, the only organs containing the intraluminal enzymes needed to transform the polyglutamates found in folic acid (the form in which they are found in food) into monoglutamates. This is why only 25–50% of dietary vitamin B9 is bioavailable. Enterocytes transform folic acid into methyltetrahydrofolate, which is absorbed by the cells and converted into tetrahydrofolate, the active form of vitamin B9. Tetrahydrofolate has a role in several cellular processes, one of the most important being thymine synthesis, which is essential for the production of nucleic acid.<sup>2,9,12</sup>

Folic acid supplements are more effective in increasing serum levels than dietary folate. Folate is absorbed by passive transport following intake of large amounts of folic acid. According to guidelines, adults should take 400 mcg/day, pregnant women 600 mcg/day, and breast-feeding mothers 500 mcg/day. In all cases, intake is limited to 1000 mcg/day.<sup>2,9,12</sup>

The most folate-rich foods include fortified cereals, red and white pinto beans (cooked), lentils, beetroot, asparagus, spinach, romaine lettuce, broccoli, and oranges. Table 2 shows the folic acid content of various foods.<sup>11,13</sup> There are 150 different forms of folate, and between 50% and 90% of

**Table 1** Dietary sources of iron.

Food	Amount	Heme (H)/non-Heme (N) iron	Iron (mg)	Calories
Tinned, drained clams	90 g	H	23.8	126
Blood sausage	1 thick slice	H	18	72
Turmeric	160 g	H	16.8	73
Cassava	160 g	H	16.8	73
Eastern oysters, wild, cooked	90 g	H	10.2	116
Soursop	1 small piece	N	5.5	90
Offal (liver, giblets), cooked	90 g	H	5.2–9.9	134–235
Coconut milk	1 1/2 cups	N	4.3	65
Cooked soy beans	1/2 cup	N	4.2	148
Roast pumpkin seeds	30 g	N	3.9	153
Prickly pear	2 pieces	N	3.6	56
Bean stew	1/2 cup	N	3.3	124
Lentil stew	1/2 cup	N	3.3	115
Fresh and boiled spinach	1 cup	N	3.2	21
Bran	8 table spoons	H	3.2	66
Lean beef (chuck or sirloin steak), cooked	90 g	H	3.1	215
Chile peppers	3 pieces	N	3	24
Cooked red beans	1/2 cup	N	2.6	97
Sardines	90 g	H	2.5	177
Cooked chick peas	1/2 cup	N	2.4	134
Lamb	90 g	H	2.3	237
Duck	90 g	H	2.3	131
Mince beef	90 g	H	2.2	212
Fortified cereals	30 g	N	1.8–21.1	54–127

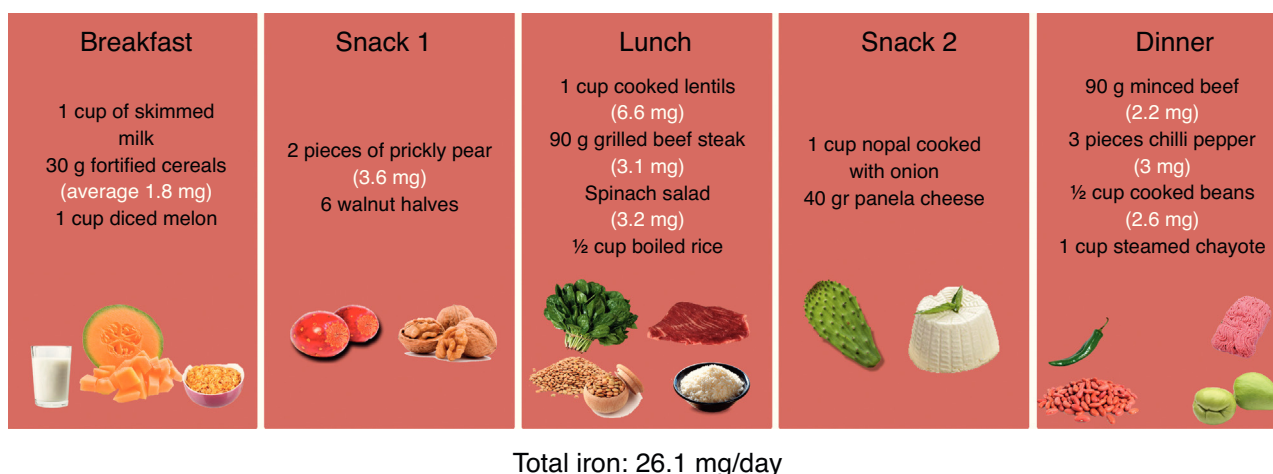
Source: Agricultural Research Service (ARS) Nutrient Database for Standard Reference, Release 27, 2014.<sup>11</sup>

dietary folate is lost during storage, cooking or processing at high temperatures.<sup>6,12</sup> Fig. 2 gives as example of a balanced diet capable of providing 866 mcg/day of folic acid.

### Vitamin B12 deficiency (cobalamin, cyanocobalamin)

Vitamin B12, together with folic acid, is known to stimulate blood and nerve cell growth. Methylcobalamin, an active form of cobalamin and a co-enzyme in tetrahydrofolate

(vitamin B9) metabolism, is essential for thymine synthesis. Cobalamin deficiency, therefore, leads to changes in DNA and RNA synthesis. Extrinsic, or dietary, intake of vitamin B12 must be complemented by the intrinsic factor, which is produced in the stomach. Many individuals over the age of 50, or those with achlorhydria, cannot absorb dietary vitamin B12. In these cases, the use of more fortified foods should be considered. The daily recommended intake of vitamin B12 in adults is 2.4 mcg/day, and 2.6 mcg/day and 2.8 mcg/day in pregnant and breast feeding women, respectively.<sup>9,13,14</sup>

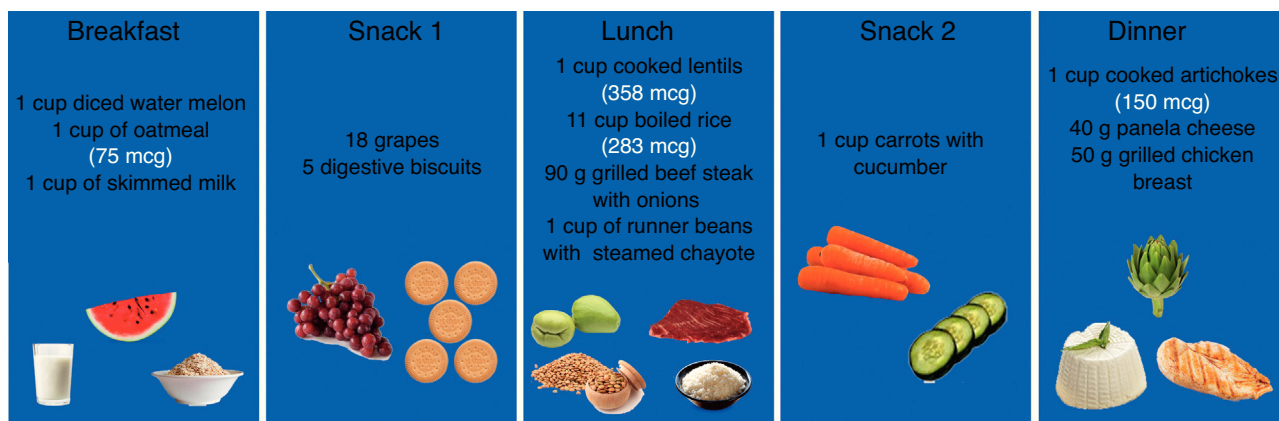


**Figure 1** Example of diet for a patient with iron deficiency anaemia.

**Table 2** Dietary sources of folic acid.

Food	Amount	Folic acid or folate (mg)	Calories
Fortified cereals	1 cup	100–400	54–127
Cooked cereal (oats, semolina)	1 cup	75–300	83
Cooked turkey giblets	1 cup	486	134–235
Cooked lentils or black beans	1 cup	358	115
Cooked pinto beans	1 cup	294	97
Chick peas	1 cup	282	134
Cooked spinach	1 cup	263	21
Boiled, enriched white rice	1 cup	283	75
Raw spinach	2 cups	232.8	28
Cooked beef liver	90 gr	221	134
Raw chayote	1/2 piece	186	19
Lettuce	3 cups	184.1	23
Cooked cabbage	1 cup	177	34
Cooked turnip leaves	1 cup	170	25
Cooked broccoli	1 cup	168	52
Cooked, enriched spaghetti	1 cup	167	171
Cooked brussel sprouts	1 cup	157	30
Cooked artichokes	1 cup	150	50
Cooked beetroot	1 cup	136	36
Raw asparagus	6 pieces	131	22
Cooked spinach	1/2 cup	131	21
Papaya	1 cup	116	110
Orange juice	1 cup	110	108
Spring onions	6 pieces	92	92
Raw rocket	4 cups	77.6	20
Cooked cauliflower	1 cup	55	28
Pumpkin flower	1 cup	54	20
Strawberries	17 pieces	49	65
Raw celery	1 1/2 cups	48.5	22
Oranges	2 pieces	45.7	72
Kiwi	1 1/2 pieces	43.3	69
Tinned corn on the cob	1/2 cup	40	66

Source: Agricultural Research Service (ARS) Nutrient Database for Standard Reference, Release 27, 2014.<sup>11</sup> Sistema Mexicano de Alimentos Equivalentes. 4th Edition, 2014.



Total folic acid: 866 mcg/day

**Figure 2** Example of diet for a patient with folate deficiency anaemia.

**Table 3** Vitamin B12 content of animal and plant foods.

Food	Amount	Vitamin B12 (mg)	Calories
Lamb, loin, cooked	90 g	2.7	237
Fortified cereals	1 cup	1–6	54–127
Tinned tuna, in water, drained	90 g	2.5	176
Cooked salmon	90 g	2.4	165
Beef mince, 90% lean, cooked	90 g	2.3	212
Round of beef, cooked	90 g	1.4	215
Natural, low fat yoghurt	1 cup	1.4	139
Roast turkey	90 g	1.3	114
Fat-free milk	1 cup	1.3	86
Low fat cottage cheese	120 g	0.7	86
Pork loin, boneless, cooked	90 g	0.6	126
Soy milk/fortified rice milk	1 cup	0.6	79
Chicken, breast, cooked	90 g	0.5	103
Cheddar cheese	1 slice	0.2	170
American cheese	30 g	0.2	82

Source: Agricultural Research Service (ARS) Nutrient Database for Standard Reference, Release 27, 2014.<sup>11</sup>

Vitamin B12 does not occur naturally in plant foods; therefore, vegetarians at risk for vitamin B12 deficiency should be closely monitored. Absorption is improved with riboflavin, niacin, magnesium and vitamin B6.<sup>9,14</sup> Table 3 shows the vitamin B12 content of animal foods and fortified plant foods. Fig. 3 shows a dietary regimen capable of supplementing vitamin B12 deficiency. Note that, contrary to popular belief, large amounts of red meat are not essential in this diet.

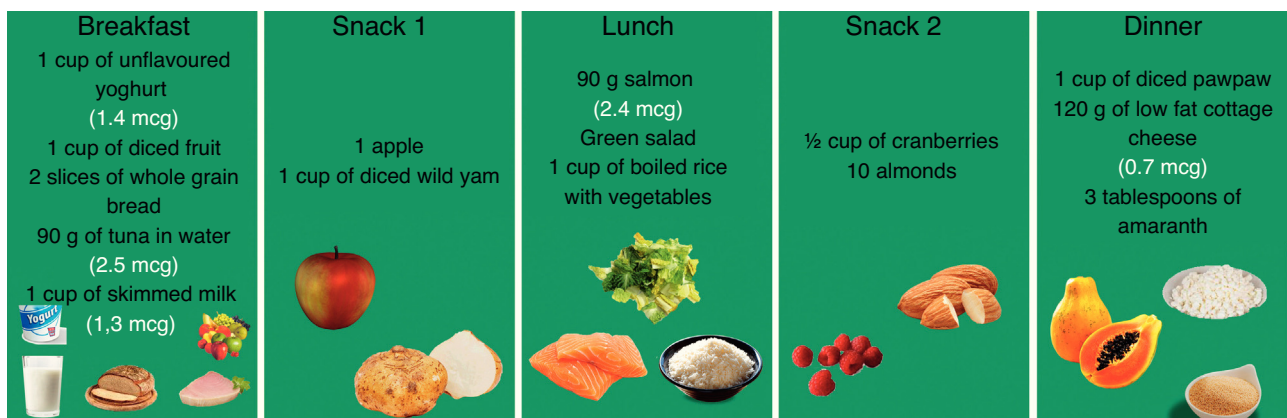
### Pharmacological management

In addition to nutritional recommendations, deficiency anaemia must also be treated pharmacologically with supplements appropriate to each type of anaemia. In patients with iron deficiency anaemia, first line therapy should be oral supplements, with intravenous administration being reserved for patients intolerant of oral supplements, with

poor intestinal absorption due to prior surgery, or with cancer-related anaemia. In the case of megaloblastic anaemia, oral therapy should also be considered first, except in patients with pernicious anaemia (atrophic gastritis leading to loss of parietal cells associated with intrinsic factor expression). Table 4 shows a summary of products available for the treatment of anaemia.<sup>15–17</sup>

### Take-home message

Vitamin supplements are currently available in various different presentations and formulations. These, due to regulatory loopholes, are sold over the counter with no guidance on individual dosage requirements or correct administration. Physicians should be aware of this situation, and understand that management of anaemia involves more than pharmaceutical remedies; these, after all, can easily be obtained over the counter by patients, without the



Total vitamin B12: 8.3 mcg/day

**Figure 3** Diet for patients with vitamin B12 deficiency anaemia.

**Table 4** Pharmacological management of anaemia.

Formulation	Dose and route of administration	Duration of treatment	Comments
<b>Iron deficiency anaemia</b>			
<i>Ferrous sulphate</i>	200 mg, oral, equivalent to 65 mg elemental iron	3–6 months	Indicate the dose needed to meet elemental iron requirements: Adults: 100–200 mg/day Children: 3–6 mg/day
<i>Ferrous fumarate</i>	350 mg, oral, equivalent to 115 mg elemental iron		
<i>Iron polymaltose</i>	357 mg, oral, equivalent to 100 mg elemental iron	3–6 months (only follow-up)	Take 1 hour before and 3 hours after meals
<i>Iron dextran</i>	100 mg, intravenous, equivalent to 100 mg elemental iron		
<i>Ferric gluconate</i>	125 mg, intravenous, equivalent to 125 mg elemental iron		
<i>Iron sucrose</i>	100 mg, intravenous, equivalent to 100 mg elemental iron		Administer in a single dose, or divide over several days.
<i>Ferric carboxymaltose</i>	50 mg, intravenous, equivalent to 50 mg elemental iron		
<b>Megaloblastic anaemia</b>			
<i>Folic acid (vitamin B9)</i>	1.5 mg/day, oral	3–4 months (chronic in some cases)	Continue until anaemia resolves Take 1 h before meals
<i>Cyanocobalamin</i>	1000–1200 mcg/day, oral 1000 mcg/day		

need to consult their doctor. This is where the importance of primary and secondary non-pharmacological measures lies. Advising patients on the right diet to complement their pharmacological therapy has many important advantages: (1) It will enable dietary sources to complement supplements to build up body reserves; (2) It will help patients avoid food that interfere with the absorption of dietary iron, and even of prescribed supplements; (3) It will prevent interactions between food and iron supplements that can aggravate adverse effects; (4) It will teach patients about the importance of diet, so that after their therapy they will continue to eat iron- or vitamin B-rich foods and avoid a recurrence of anaemia.

### Conflict of interest

The authors declare that they have no conflict of interests.

### References

- Yildirim T, Yalcin A, Atmis V, et al. The prevalence of anaemia, iron, vitamin B12, and folic acid deficiencies in community dwelling elderly in Ankara, Turkey. *Arch Gerontol Geriatr*. 2015;60:344–8.
- De Paz R, Canales MA, Hernández-Navarro F. Anemia megaloblástica. *Med Clin (Barc)*. 2006;127:185–8.
- Kassebaum NJ, Jasrasaria R, Naghavi M, et al. A systematic analysis of global anemia burden from 1990 to 2010. *Blood*. 2014;123:615–24.
- Prevención, Diagnóstico Y Tratamiento de La Anemia Por Deficiencia de Hierro En Niños Y Adultos. México, D.F., México: Secretaria de Salud; 2010. Available from: [www.cenetec.salud.gob.mx/interior/gpc.html](http://www.cenetec.salud.gob.mx/interior/gpc.html) [accessed 09.01.15].
- Muñoz-Gómez M, Ramírez-Ramírez G, Campos-Garríguez A, et al. Fisiopatología del metabolismo del hierro: implicaciones diagnósticas y terapéuticas. *Nefrología*. 2005;25:9–19.
- Sotelo A, González-Osnaya L, Sánchez-Chinchillas A, et al. Role of oxate, phytate, tannins and cooking on iron bioavailability from foods commonly consumed in Mexico. *Int J Food Sci Nutr*. 2010;61:29–39.
- Forrellat Barrios M, Gautier du Défaix Gómez H, Fernández Delgado N. Metabolismo del hierro. *Rev Cuba Hematol Inmunol y Hemoter*. 2000;16:149–60.
- Andrews NC. Disorders of iron metabolism. *N Engl J Med*. 1999;341:1986–95.
- Escott-Stump S. Hematología: Anemias y trastornos sanguíneos. In: *Nutrición Diagnóstico Y Tratamiento*. 7a ed. Barcelona: Lipincott Williams & Wilkins; 2012.
- Muñoz M, García-Erce JA, Remacha ÁF. Disorders of iron metabolism Part II: iron deficiency and iron overload. *J Clin Pathol*. 2011;64:287–96.
- USDA National Nutrient Database for Standard Reference – Release 27. Washington DC, USA; 2014. Available from: <https://www.ars.usda.gov/Services/docs.htm?docid=8964> [accessed 10.01.15].
- Paz R, de Hernández-Navarro F. Manejo, prevención y control de la anemia megaloblástica secundaria a déficit de ácido fólico. *Nutr Hosp*. 2006;21:113–9.
- Pérez L. Sistema Mexicano de Alimentos Equivalentes. 4a ed. Distrito Federal, México: Fomento de Nutrición y Salud A.C; 2014.

14. Stabler SP. Vitamin B12 deficiency. *N Engl J Med.* 2013;368:2041–2.
15. Camaschella C. Iron-deficiency anemia. *N Engl J Med.* 2015;372:1832–43.
16. Carmel R. How I treat cobalamin (vitamin B12) deficiency. *Blood.* 2008;112:2214–21.
17. Pitkin RM, Allen LB, Bailey LB, et al. Dietary reference intakes for thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, pantothenic acid, biotin, and choline. Washington DC: National Academies Press (US); 1998.