

VITAMIN B12

VEGAN MOTHERS AND THEIR BABIES

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Vitamin B12

For Vegan Mothers and Their Babies

Foreword

This paper was written following several serious cases of infant vitamin B12 deficiency in our region and the death of a baby in New Zealand. I am very grateful for the help I received from paediatricians and my colleague dietitians. This paper has been reviewed and is endorsed by Community Paediatrician Dr. Nick Baker. I would also like to acknowledge the assistance from Dr. Helen Kingston from Golden Bay Medical Centre and from Sally McKay, registered nutritionist from Nelson. This paper is intended for all health professionals who work with pregnant women, babies and young children in our community. The aim is to provide consistent information in order to prevent vitamin B12 deficiency and its serious complications. A multi-disciplinary approach is recommended. Vigilance by all lead maternity carers, primary and complementary health care providers should lead to early detection and appropriate referral (e.g. to paediatrician and/or dietitian).

Marion Van Oeveren, Public Health Dietitian, October 05

Introduction

Vitamin B12, or cobalamin, is an essential vitamin that is water-soluble and can be stored in the liver. Vitamin B12 is essential for normal blood and neurological function. Vitamin B12 is naturally found in animal products such as meat, dairy products and eggs. People on strict vegetarian or vegan diets may become deficient in vitamin B12 if adequate fortified foods or supplements are not consumed. In adults liver stores can last 2-6 years if no vitamin B12 is ingested.

Infant tolerance to inadequate supply and deficiency of vitamin B12 is much less than adult tolerance. The amount of vitamin B12 transported to the foetus is related to the mother's intake of the vitamin in pregnancy. Infants of vegan mothers therefore may be born with a B12 deficiency even if the mother has become vegan only recently and without any signs of maternal deficiency. Breastfed infants of vegans are also likely to receive vitamin B12 deficient milk if the mother's intake of vitamin B12 is inadequate.

1. Deficiency

Vitamin B12 deficiency can be caused by:

1. Not consuming vitamin B12 containing animal foods such as meat, fish, eggs or dairy products (strict vegetarian and vegan diets)
2. Lack of intrinsic factor production due to atrophy of the gastric mucosa.
The amount of intrinsic factor commonly decreases in the elderly. This is rare in younger people but pregnant/breastfeeding mothers can lack intrinsic factor, especially if the mother is older.
3. Some diseases of the stomach or small intestine can cause inadequate absorption of vitamin B12.

A deficiency of vitamin B12 can lead to the development of megaloblastic anaemia (pernicious anaemia) and can cause neurological damage. Symptoms of anaemia include lethargy and loss of appetite. Symptoms of nerve cell damage may include numbness/tingling in hands and feet, sore tongue, poor muscle co-ordination, depression, irritability, memory loss and personality changes.

In adults symptoms often develop slowly over several months or a year. If vitamin B12 stores start off adequately it can take 2-6 years before a deficiency develops.

Infants typically show a much more rapid onset of symptoms. Vitamin B12 deficiency can be difficult to detect or mis-diagnosed, for example as gastroenteritis. The symptoms of infant vitamin B12 deficiency include repetitive vomiting, drowsiness, swallowing problems, constipation and tremor. Vitamin B12 deficiency can rapidly lead to failure to thrive and if not promptly corrected can lead to coma or death. Infants are also more vulnerable to permanent damage.

Note:

With sub-optimal intakes of Vitamin B12 there may be no clinical symptoms of deficiency, but marginal B12 status can lead to elevated homocysteine levels, which is a risk factor for cardiovascular disease. Be aware that folate deficiency may co-exist with vitamin B12 deficiency.

2. Testing

The threshold for testing vegan individuals should be lower, especially in pregnancy.

Methods of testing

- Indications of vitamin B12 deficiency may appear on the full blood count result, e.g. as raised MCV or low neutrophil count.
- A **serum B12** measurement can be done. This may not be a reliable test for vegans in particular if algae are consumed (e.g. Spirulina). Algae contain B12 - analogues and can give a false result. High folate intakes can also mask vitamin B12 deficiency.
- The most specific test for B12 status is **methylmalonic acid (MMA testing)**. Vitamin B12 is required to metabolise MMA, therefore if there is insufficient vitamin B12, MMA levels will increase.
- Blood homocysteine testing is less specific with levels less than 15 mmol/L desirable.
- *Note: All tests are free to the patient*

Screening and testing of pregnant women and their infants

The following screening points can be used with the mother to assess the need for further vitamin B12 testing:

- Previous B12 deficiency and previous or current megaloblastic anaemia
- Strict vegetarian or vegan diet
- Prescription drugs (drugs such as oral contraceptives and anticonvulsants may cause low vitamin B12 levels)
- Any conditions of the gastro-intestinal tract such as inflammatory bowel disease or gastrectomy

If concerns arise from the above screening questions it is recommended that a woman is tested as early as possible in pregnancy, or when planning a pregnancy.

For women on a strict vegetarian or vegan diet, the following questions can help assess the likelihood that they will be vitamin B12 deficient.

- ◆ Strictness of vegetarian/vegan diet. Are eggs and/or dairy foods regularly consumed.
- ◆ Duration of vegan diet
- ◆ Vitamin B12 supplement use (see section on supplements)
- ◆ Use of fortified soy milk and other fortified foods (not all soy milks are fortified)
- ◆ Food allergies/intolerance, food avoidance
- ◆ Other foods excluded in the past 10 years
- ◆ Number of previous pregnancies and length of breastfeeding

The absorption rate of B12 will vary between people. Additionally the actual amount of active B12 in a product may vary from that stated on the label due to a variety of factors. Please note that it may appear that a vegan woman is consuming the recommended amount, but unless her B12 levels are tested, you cannot be sure sufficient B12 is consumed and absorbed. **Vigilance at all times is recommended. Inadequate B12 in pregnancy can lead to permanent foetal damage with impaired growth, increased risk of abortion and miscarriage, impaired brain development. Expert advice should be sought where abnormal levels of active B12 (MMA level) are found.**

If concern exists about a mother's B12 blood level or inadequate dietary intake her baby will need to be tested at birth (cord blood). An infant may be born with apparently normal B12 levels but may rapidly develop a B12 deficiency when their only source of nutrition is vitamin B12 deficient milk. If any tests are abnormal or if any other concerns arise paediatric advice should be sought immediately. Management usually consists of a course of vitamin B12 injections. At all times the breastfeeding mother's intake of vitamin B12 needs to be optimised.

Note:

The level at which vitamin B12 is adequate differs between people. Additionally, because of the analogues, a mother's serum vitamin B12 level may appear normal, but she may be vitamin B12 deficient. Therefore it is recommended to measure her MMA levels as this is the only test to establish if they are truly deficient.

3. Vitamin B12 intake

Recommended daily dietary intakes

<i>Age</i>	<i>Recommended Intake (micrograms)</i>
0-6 months	0.3 µg
7-12 months	0.7 µg
1-3 years	1 µg
Adult women	2 µg
Pregnant women	3 µg
Breastfeeding women	2.5 µg

Source: Recommended Dietary Intakes for Use in Australia (National Health and Medical Research Council 1990)

Sources of Vitamin B12

Plant products do not provide Vitamin B12. It is naturally found in foods derived from animals, including meat, fish, eggs and dairy products. This is because vitamin B12 is produced in an animal's digestive tract by bacteria, and then becomes incorporated into the animal's meat or milk.

To ensure adequate Vitamin B12 intake, vegans must eat fortified foods, take supplements or a combination of both. Bacteria in the human gut produce Vitamin B12 but this is not sufficient to prevent deficiency.

Fortified Foods

Vitamin B12 is not found in plants, except when they are contaminated by bacteria, so they are not a reliable source of the vitamin. Seaweed, spirulina and tempeh contain an inactive form of B12, which is not used by the human body. Plant foods that are not fortified do not contain vitamin B12. For example fortified yeast products contains vitamin B12 but not brewer's yeast or baker's yeast.

A variety of foods are fortified with B12 such as soy milk and rice milk, and some processed soy foods. A cup of fortified soy milk contains 1 µg, which is 40% of a breastfeeding women's daily requirement. Not all soy or rice milks are fortified with B12, so check the label.

Food source	Vitamin B12 (µg) Per 100g	Vitamin B12 (µg) Per serve
Beverages		
<i>So Good</i> soy drink 'Essential' (250ml)	0.2 µg	0.5 µg
<i>So Good</i> soy drink (250ml) Flavours, Lite, Regular, Soyaccino	0.4 µg	1.0 µg
<i>Soy Dream Enriched</i> soy drink (240ml)	1.3 µg	3.0 µg
<i>Rice Dream Enriched</i> rice drink (240ml)	0.6 µg	1.5 µg
<i>Bean Supreme SoyPlus</i> soymilk (250ml)	0.2 µg	0.5 µg
<i>Sanitarium Up & Go</i> liquid breakfast (250ml)	0.36 µg	0.9 µg
<i>Sanitarium Fastbreak</i> breakfast smoothie (250ml)	0.2g µg	0.5 µg
Foods		
<i>So Good</i> Ice-cream (2 scoops)	0.24 µg	0.24 µg
<i>Marmite</i> 1 teaspoon (5g)	10 µg	0.5 µg
<i>Longalife no-chicken breast fillet</i> (2 fillets)	1.0 µg	0.8 µg
<i>Bean Supreme</i> Vegetarian Sausages (1 sausage)	1.25 µg	0.94 µg

4. Supplements: oral/injections

Oral supplements

- Healtheries Multi-vitamin Tab (fully subsidised) (3 µg B12 only - many over the counter preparations have higher levels of B12)
- Paediatric: Vidaylin (Abbot t) or KidsCare Multivitamin & Mineral Chewable Tablets (Healtheries) or Floradix Liquid Iron Formula (not subsidised)
- *Note: the fully subsidised Apo-B-Complex (Apotex), vitamin B complex supplement does not contain any vitamin B12.*

Injection

- NeoCytamen (GlaxoSmithKline). For more information: www.medsafe.govt.nz. For data sheet search for Neo-Cytamen (under Trade name) or hydroxocobalamin (under Ingredient name) using health professional hyperlink. Partly subsidised.

When reviewing supplement use consider the following:

- Over the counter multivitamin preparations contain anything between 1 and 50 µg B12 per tablet. Always check the labels and also consider the fortified foods that are used.
- Some supplements may contain analogues. Products such as Spirulina, algae and tempeh also contain analogues. If in doubt about the level of active vit B12 in the diet or supplements a MMA test needs to be ordered.
- Some vegans will be reluctant to use supplements because some ingredients may be derived from animal sources. Some will order from overseas to obtain

supplements that are approved by vegan organisations. Always ask if they can bring in the supplements they are taking so you can check the label.

5. Advice for Pregnant and Breastfeeding Mothers

Follow the advice in the *Food and Nutrition Guidelines* for Pregnant and Breastfeeding Women.

Protein

Choose at least 2 servings of plant proteins a day (1 serving = $\frac{3}{4}$ cup dried legumes). Select a variety of vitamin B12 fortified foods every day.

Iron

Iron requirements are higher, especially during pregnancy. Iron-rich foods include green leafy vegetables, legumes, fortified cereals, tofu, nuts, and dried fruit. However the iron from plant foods is non-haem iron which is less well absorbed. Women who may have low intakes of iron should have their iron levels tested.

Calcium

It is recommended that pregnant and breastfeeding women consume 3 serves of milk products daily to ensure adequate calcium. Fortified soy milk or rice milk is suitable. Plant foods high in calcium include wholemeal bread, peanuts, broccoli, spinach, legumes and tofu.

Vitamin B12

Read the labels to see how much vitamin B12 is consumed to ensure daily recommended intakes are met. Remember that seaweed, spirulina and tempeh do not contain active B12.

A pregnant woman requires 3ug per day. To consume this through fortified foods you would need to include fortified foods at most meals and snacks.

Consuming **all** of the following foods = 3.44 μ g B12.

Breakfast

Cereal with $\frac{1}{2}$ cup fortified **soy milk** 0.5 μ g B12

Lunch

2 slices toast with **Marmite** 0.5 μ g B12

Snack

1 cup flavoured **soy drink** 1 μ g B12

Dinner

Rice and vegetables with 1 vegetarian sausage 0.94 µg B12

Dessert

Custard made with ½ cup fortified soy milk 0.5ug B12

6. Advice for solids for Vegan infants and toddlers

As nutritional adequacy can be difficult to achieve in infants, toddlers and children, it is recommended that vegan families see a dietitian for a nutritional assessment and advice. When concerns arise, MMA levels should also be checked as sub clinical vitamin B12 deficiency can have impacts on health, well being and development.

Solid foods are generally introduced from 6 months. Breastfeeding or infant formula is still a key source of nutrients. Soy milk, rice milk or homemade formulas are not adequate in the first year.

Follow the *Food and Nutrition Guidelines for 0-2 year olds* but consider the nutrients below as vegan infants may be at risk from deficiency of these.

Iron

After 6 months, breast milk does not provide adequate iron. Weaning foods need to be rich in iron. Infants exclusively breast-fed after 6 months may need iron supplements prescribed by a doctor. Include Vitamin C rich foods with meals to improve iron absorption. These include most fruits and vegetables. Good vegan sources of iron are fortified cereals, legumes, tofu, nuts and dried fruits. Vegan diets contain phytate and other factors that inhibit iron absorption.

Energy

Infants and toddlers are growing quickly and need plenty of energy. They do not require a low fat diet. Nut butters (e.g. tahini), oils, avocado and soy products provide good sources of energy.

Fibre

Fibre intakes of vegan infants and toddlers are generally high due to the consumption of only plant foods. Too much fibre can reduce the absorption of some minerals. Also fibre can fill small stomachs quickly, reducing the amount of food an infant or toddler can consume. Include lower fibre foods such as refined grains, peeled fruits and vegetables.

Zinc

Good sources of zinc include legumes, nut products and tofu. The phytate in high fibre foods may reduce the absorption of zinc.

Calcium

The best sources of calcium are fortified foods such as soy and rice milks. Other sources are tofu, legumes, dried fruit and nuts.

Protein

A variety of protein sources are required during the day to provide all the essential amino acids. Good sources are soy products, legumes, grains, nut butters and seeds.

Infant Formula

The NZ Ministry of Health recommends cow's milk based formulas for those infants who are not breast-fed. Standard Infant and Follow On formulas are cow's milk based and are therefore not appropriate in a strict vegan regime. Soy based formulas should only be used in consultation with a health professional.

Food Ideas

For ideas for pre-prepared foods see Appendix 1

Around 6 months start with these first foods:

- Fortified baby cereals with milk*
- Mashed/pureed apple, pear, apricot, peach, banana
- 7 months when baby is used to solid foods:
 - Pureed legumes (lentils, chickpeas, kidney beans black-eyed beans etc, well-cooked)
 - Pureed green vegetables
 - Mashed root vegetables
 - Pureed root vegetables eg Kumara, potato, pumpkin, carrot.

At 8-9 months add:

- Porridge made with milk*
- Rice
- Weetbix
- Tofu and baked beans
- Finely chopped vegetables – add a greater variety
- Soft, peeled fruits (choose fruit high in vitamin C to increase iron absorption)
- White bread with avocado, marmite
- Soy luncheon**
- Soy milk* made into custards or milk puddings
- Soy yoghurt**

At 10-12 months add:

- Whole legumes well-cooked, e.g. in a casserole.

After one year add:

- Whole fruits
- Nut patties **– using finely ground nuts
- Nut butters**

*Use breast milk or infant formula as the main milk drink for infants under one. Full-fat soy milk fortified with B12 and calcium can be used as the main milk drink from age one year.

**Introduce nuts and soy products after one year if concerned about allergies. Avoid peanuts and peanut products until age 3.

References/more information:

- ◆ Food and Nutrition Guidelines for Healthy Pregnant and Breastfeeding Woman, A background paper, draft for consultation, Ministry of Health, 2005.
- ◆ Food and Nutrition Guidelines for Healthy Infants and Toddlers, A background paper, Ministry of Health, 2000
- ◆ Position of the American Dietetic Association, Vegetarian diets, available at www.eatright.org

- ◆ Useful websites:
 - www.vrg.org.nutrition/pregnancy.htm
 - www.sanitarium.org.nz
 - www.llu.edu/llu/vegetarian.vegnews.htm
 - www.sdada.org/facts&fiction.htm
 - www.veganoutreach.org/whyvegan/health.html
 - www.vegansociety.com/html/info/b12sheet.html

**For more information contact the Paediatricians or Dietitians at Nelson Hospital
03 546 1800**

Appendix 1

Suitable Prepared foods for Infants and Toddlers

The major baby-food manufacturers in New Zealand do not recommend a vegan dietary regime for infants and toddlers. However some of their foods are suitable. The following foods do not contain animal products.

Under the *Australia New Zealand Food Standards Code*, it is NOT possible to add vitamin B₁₂ or calcium to infant foods. The only permitted nutrients that may be added to food products for infants (under 12 months) are: iron, vitamin C, thiamin, niacin, folate, vitamin B₆, and magnesium.

It is only possible to add Vitamin B₁₂, Calcium, Zinc, and Iron (plus other vitamins and minerals) to products for 1-3 year olds if the product is a supplementary food and contain minimum levels of protein and energy.

Heinz Wattie

It is Heinz Wattie's Ltd company policy to use only ingredients that are certified GMO-free. Infant cereals do contain added iron.

- Wattie's Rice Cereal with Apple – from 4 months
- Farex Baby Rice – from 4 months
- Farex Original Cereal – from 6 months

Wattie's 110g jars - from 4 months (blue label):

- Fruit Apple
- Fruit Pear
- Pear & Banana
- Apple & Mango
- Pumpkin & Sweetcorn
- Potato, Peas & Broccoli
- Parsnips, Carrots & Kumara

Wattie's 120g cans – from 4 months (blue label):

- Apples
- Pears
- Fruit salad
- Apple & Peach
- Pumpkin & Sweetcorn
- Carrots & Rice

Wattie's Organics 110g jar – from 4 months (blue label):

- Pumpkin, Sweetcorn & Zucchini
- Sweet Baby Vegetables
- Golden Vegetable Mash
- Fruity Pear & Apricot swirl

Wattie's 170g jar – from 6 months (red label):

- Pear & Banana

Wattie's Organics 170g jar – from 6 months (red label):

- Harvest Vegetable Risotto
- Orchard Plum Delight

Wattie's 170g jar – from 9 months (green label):

- Pear, Mango & Pineapple
- Apple, Pear & Blueberry

Wattie's Organics 170g jar – from 9 months (green label):

- Apple & Cinnamon Porridge

Wattie's 110g jar –All Ages, from 6 months (yellow label):

- Apple & Blueberry Muesli
- Apple & Oatmeal

Wattie's 120g can – All Ages, from 6 months (yellow label):

- Apple & Cereal

Wattie's Toddler Foods

- Wattie's Little Kids – Saucy Baked Beans

Robinsons' Products

Nutricia New Zealand's policy on GE foods is that the company sources GM free ingredients to the best of their ability.

Robinsons' Jar foods:

- Mixed Fruit Medley
- Vegetable and Apple Casserole.

Robinsons' packet foods:

- Baby Rice
- Summer Fruit Salad