VITAMIN B2, RIBOFLAVIN
71 ABSTRACT SUMMARIES

PubMed search of:
Riboflavin, therapeutic = 889 hits
Riboflavin, deficiency = 1,432 hits
Riboflavin, human = 2,753 hits
Riboflavin, animal = -2,881- hits
Riboflavin, benefit = 22 hits

MESH search of:
Riboflavin, therapeutic = 138 hits
Riboflavin, deficiency = 454 hits

Vitamin B2 Overview
Vitamin B2, or riboflavin, is a water-soluble vitamin. It functions primarily as a coenzyme for many metabolic processes in the body It plays an important role in releasing energy from carbohydrates, fats and proteins. It also helps to maintain the integrity of red blood cells and nervous system function. Riboflavin is involved in energy production as part of the electron transport chain that produces cellular energy. As a building block for FAD (flavin adenine dinucleotide), riboflavin is a crucial component in converting food into energy. FAD is required for electron transport and ATP production in the Krebs cycle. Riboflavin deficiency is usually due to dietary inadequacy but can occur most frequently in people with long-standing infections, liver disease, and alcoholism. The first signs and symptoms of deficiency are a sore throat and sores at the corners of the mouth. Worsening symptoms include a swollen tongue, seborrheic dermatitis, anemia and impaired nerve function. Ongoing research shows that Vitamin B2 may increase energy levels; reduce chronic fatigue; and improve concentration and mood.

As with most B vitamins, the more food you eat, the more B vitamins you need to support the metabolic processes that will convert that food into usable energy. Riboflavin needs are elevated during pregnancy and lactation as well as by the use of oral contraceptives (birth control pills). Athletes may require more riboflavin due both to increased caloric intake and increased needs of exercise.

Dietary Sources: Liver, dairy products, dark green vegetables and many types of seafood are good sources of riboflavin.

Dosage: The RDA for Vitamin B2 ranges from 1 mg to 1.6 mg for lactating women

Side Effects: No serious side effects have been reported for supplementation with riboflavin at levels several times above the DV of 1.7mg. High supplemental levels are likely to result in a bright yellow color of the urine as excess is excreted.

(Source: www.supplementwatch.com)

Research Overview

Riboflavin deficiency has been shown to contribute to:

1. Preeclampsia
2. Negative effect on physical performance
3. Negative effect on growth and development in children
4. Less effective niacin and vitamin B6 metabolism
5. Nutritional anemia
6. Low gastric acid production and therefore contribute to acid reflux and potential stomach cancer
7. Reduction in metabolism of vitamin B6 and folate
8. Reduction in metabolism of supplemental iron
9. People with congestive heart failure have lower levels of riboflavin
10. Teenage girls tend to have low levels of riboflavin
11. Decreased immune response
12. Impairment in leukocyte function
13. Angular stomatitis in cystic fibrosis
14. Esophagus and gastric cancer
15. Increased respiratory infection in children
16. Increased risk in cardiovascular disease
17. Decreased calcium levels in bone
18. More easily broken bones
19. Low iron concentration in heart, liver and spleen
20. Increased copper concentration in heart and liver
21. Impaired gastrointestinal development
22. Development of cataracts

Riboflavin supplementation has been shown to:

1. Be an effective treatment for migraines without neurological side effects
2. Prevent ischemia-reperfusion injury
3. Improve mitochondrial encephalomyopathy (MEM)
4. Improve symptoms of muscle fatigue
5. Improve stroke-like occurrences
6. Reduce respiratory failure
7. Improve involuntary eye movement
8. Improve edema in the cornea
9. Improve energy metabolism
10. Help prevent cataracts
11. Have potential benefits in preventing osteoarthritis
12. Halt and reverse precancerous mouth lesion development
13. Be an effective treatment in ethylmalonic encephalopathy
14. Be an effective treatment for MELAS [mitochondrial myopathy, encephalopathy, lactic acidosis, and stroke-like episodes.) when combined with idebenone
15. Inhibit development of gonarthrosis (knee arthritis)
16. Degrade cholesterol
17. Improve functional motor performance

18. Potentially prevent endometrial cancer
19. Be a treatment for P. falciparum malaria
20. Prevent dysplasia of the esophagus from developing into cancer
21. Improve iron metabolism
22. Improve zinc metabolism
23. Reduce the risk of alcohol cirrhosis
24. Potentially enhance fetal growth
25. Influence homocysteine metabolism

Following are some important aspects of riboflavin

1. Those eating vegan diets may be deficient in riboflavin
2. Vegetarians tend to have lower riboflavin levels
3. Many children with cardiac disease, especially congestive heart failure, have riboflavin deficiency
4. Riboflavin supplies metabolic pathways and therefore is at risk of depletion in athletic people
5. Women's riboflavin levels tend to be lower during periods of exercise and/or dieting
6. Elderly people tend to be deficient in riboflavin
7. Those with active rheumatoid arthritis tend to have riboflavin deficiency
8. Riboflavin may be effective in photochemical decontamination
9. Those with chronic fatigue syndrome tend to have riboflavin deficiency
10. Those using oral contraceptives may require riboflavin supplementation
11. Anorexic with low riboflavin levels tend to have lower body weight
12. Those with neuropathy tend to have low levels of riboflavin
13. Women with intrauterine growth retardation (IUGR) tend to have riboflavin deficiency
14. Those with severe burn injuries have low riboflavin levels

VITAMIN B2: 71 RESEARCH SUMMARIES

HUMAN RESEARCH

1. Ann Nutr Metab. 1996;40(3):146-56.

Influence of the intake of fortified breakfast cereals on dietary habits and nutritional status of Spanish schoolchildren.

Ortega RM, Requejo AM, Redondo R, Lopez-Sobaler AM, Andres P, Ortega A, Gaspar MJ, Quintas E, Navia B.

Spain

This paper reports on the breakfast choices of 200 schoolchildren between 9 and 13 years of age. One group had fortified breakfast cereals (65 boys and 35 girls) and the second group did not (64 boys and 36 girls). Blood, biochemical, anthropometric, and dietary data were collected. The fortified breakfast group among other factors had better dietary habits all round and higher thiamine, pyridoxine, folates, and beta-carotenes. The fortified breakfast children had higher retinol, serum folate, and riboflavin levels than the non-fortified group. The percentage of children with hypercholesterolaemia (serum cholesterol > 4.5 mmol/l) was higher amongst those of the non-fortified group: 37% as compared with 18% of the fortified group.

HUMAN RESEARCH

2. Arch Latinoam Nutr. 1996 Sep;46(3):190-5.

Nutritional status and body composition of a group of non-institutionalized elderly in the State of Zulia, Venezuela

Falque-Madrid L, Pinero-Corredor MP, Zambrano de Rodriguez N, Quintero J, Souki de Gabarron A, Arias-Marquez N.

Venezuela

This study assessed the nutritional status and body composition of an elderly population of ninety-four persons (47 male and 47 female), ages ranging from 60 to 88 years. Anthropometric measurements, and a dietary recall and frequency were taken. The authors found that intake of carbohydrate, fiber, vitamin A, riboflavin, zinc, and copper is low among males and females according RDA values. Beyond that they found a high incidence of obesity and overweight due to poor diet.

HUMAN RESEARCH

3. J Nutr. 2003 Mar;133(3):668-72.

Oxidative folding of interleukin-2 is impaired in flavin-deficient jurkat cells, causing intracellular accumulation of interleukin-2 and increased expression of stress response genes.

Camporeale G, Zempleni J.

USA

In this cellular study it was found that riboflavin-deficient cells exhibited cellular stress. The authors concluded that their findings are consistent with the hypothesis that riboflavin deficiency may cause cellular stress by accumulation of unfolded proteins in human cells.

PMID: 12612135

HUMAN RESEARCH

4. AIDS Rev. 2003 Jan-Mar;5(1):36-43.

Hepatotoxicity of antiretroviral therapy.

Kontorinis N, Dieterich D.

USA

In this discussion of liver toxicity as a serious complication in HIV patients taking antiretroviral therapy the authors concluded that nucleoside-induced mitochondrial damage to the liver may improve with riboflavin or thiamine therapy.

PMID: 12875106

HUMAN RESEARCH

5. Cardiology. 2003;99(4):177-81.

Dietary intake of various nutrients in older patients with congestive heart failure.

Gorelik O, Almoznino-Sarafian D, Feder I, Wachsman O, Alon I, Litvinjuk V, Roshovsky M, Modai D, Cohen N.

In a study that assessed dietary intake in patients with congestive heart failure (CHF) 57 CHF patients on furosemide were compared with 40 patients without CHF. However, the intake of all patients fell short of recommended allowances in several nutrients: magnesium, calcium, zinc, copper, manganese, energy, thiamin, riboflavin, and folate.
PMID: 12845243

HUMAN RESEARCH
6. J Nutr. 2003 Jan;133(1):211-4.
Regional variations of blood pressure in the United States are associated with regional variations in dietary intakes: the NHANES-III data.
Hajjar I, Kotchen T.
USA
The authors acknowledge that the southern region of the United States has had the highest stroke mortality rate and a more prevalent and resistant hypertension. Using data from the National Health and Nutritional Examination Survey III (NHANES-III), nutritional variables were selected to determine an association with blood pressure. Of the 17,752 participants in the survey who were 18 y of age or older, the south had the highest systolic and diastolic blood pressures and reported the highest consumption of monounsaturated fatty acids, polyunsaturated fatty acids and cholesterol and the least amount of fiber in the multivariate analysis. The south consumed the least potassium, calcium, phosphorous, magnesium, copper, riboflavin, niacin, iron and vitamins A, C and B-6 ($P < 0.005$). The authors concluded that the "stroke belt" has dietary patterns that may contribute to the high prevalence of hypertension and cardiovascular disease.
PMID: 12514292

HUMAN RESEARCH
7. J Nutr Health Aging. 2003;7(2):121-8
Assessment of antioxidant nutrient intake of a population of southern U.S. African-american and caucasian women of various ages when compared to dietary reference intakes.
Lewis SM, Mayhugh MA, Freni SC, Thorn B, Cardoso S, Buffington C, Jairaj K, Feuers RJ.
USA
The daily vitamin intake of 259 women living on low incomes was examined using the RDA (recommended daily allowance) and EAR (estimated average requirement) measures. The authors found that all women in this population reported dietary intakes of antioxidant vitamins and minerals below recommended values. They conclude that low intake of nutrients could contribute to subsequent health risks unless nutrient-dense food choices and antioxidant supplementation are considered.
PMID: 12679833

HUMAN RESEARCH
8. Urologiia. 2003 Jan-Feb;(1):35-41.
Structural-functional damage to cellular membranes in deficiency of vitamins A, E, B2, B6, PP in children with calculous pyelonephritis

Atadzhanov UZh, Utegenov NU.
Soviet Union
Patients with a history of kidney stones and calcification in the kidneys were assessed for nutrient deficiency and lipid levels. The authors found that lipid products and phospholipase, organ-specific enzymes are closely associated with low values of vitamins A, E, B2(riboflavin), and B6(niacin). Deficiency of these vitamins ranged from 76.8% to 94.6% in acute kidney infection associated with stones.
PMID: 12621965

HUMAN RESEARCH
9. Vopr Pitan. 2003;72(3):3-7.
[In Process Citation] to here, fill in citation
[No authors listed]
Russia
This study investigated 96 children ages 4-15 years old with decreased hemoglobin level (less 120 g/l) for vitamin levels. It was found that 90% of the children had combined deficiency of B complex vitamins and carotenoids but had enough vitamin C. Only 2% of children had normal vitamins. The authors note that the lower the riboflavin the lower the hemoglobin. They conclude that vitamin B2 is a necessity in treating iron deficiency anemia.
PMID: 12872653

HUMAN RESEARCH
10. Eur J Clin Nutr. 2002 Dec;56 Suppl 4:S16-20.
The role of fermented milk in complementary feeding of young children: lessons from transition countries.
Branca F, Rossi L.
Italy
The authors commented on the beneficial properties of breast milk, however iron deficiency sometimes results. They then reviewed the use of fermented milk and its ability to treat iron deficiency anemia in infants and children. They acknowledged that it represent an excellent source of nutrients such as calcium, protein, phosphorus and riboflavin. Furthermore during the fermentation of milk, lactic acid and other organic acids are produced, which increase the absorption of iron. They advised that fermented milk ishould be consumed at mealtimes so that these acids would have a positive effect on the absorption of iron from other foods.
PMID: 12556942

HUMAN RESEARCH
11. Eur J Clin Nutr. 2002 Dec;56(12):1162-8.
Changes in the intake of vitamins and minerals by men and women with hyperlipidemia and overweight during dietetic treatment.
Grzybek A, Klosiewicz-Latoszek L, Targosz U.
Poland

On a low-fat, low-energy diet in patients with overweight and hyperlipidemia, the levels of magnesium, thiamin and riboflavin were found to be deficient in men.
PMID: 12494300

HUMAN RESEARCH
12. Int J Vitam Nutr Res. 2002 Dec;72(6):375-82.
Seasonal variation of food consumption and selected nutrient intake in Linxian, a high risk area for esophageal cancer in China.
Zou XN, Taylor PR, Mark SD, Chao A, Wang W, Dawsey SM, Wu YP, Qiao YL, Zheng SF.
China
Nutrition Intervention Trials were conducted in Linxian, China from 1985 through 1991. In the group receiving beta-carotene, selenium, and alpha-tocopherol there was a reduction in total cancer. This present survey was to investigate food patterns, nutrient intakes, and seasonal variations in the diet in 1996 in 104 households. Taking measurements in both spring and fall, low nutrient intakes were found for selenium (79% RDA and 66% RDA), zinc (72% RDA and 62% RDA), vitamin B2 (64% RDA and 52% RDA), and calcium (53% RDA and 39% RDA). The authors concluded that the nutrient intake in Linxian is inadequate including nutrients known to be associated with esophageal cancer.
PMID: 12596503

HUMAN RESEARCH
13. Pol Merkuriusz Lek. 2002 Dec;13(78):490-6.
Dietary intake elderly subjects in rural and urban area in Poland, Rychlik E.
Poland
In this paper the authors compare the dietary habits of elderly people living in rural and urban areas. The data were collected from 591 men and women aged 61-96 years, using 24-h dietary recall. The intake of beta-carotene and ascorbic acid, in men and women and potassium and magnesium in women, was lower in rural than in urban population. The study subjects had high intake of sodium, phosphorus, vitamin A, but insufficient intake of calcium, zinc, copper, riboflavin, vitamin B6, and women had also low intake of iron, potassium, thiamin and niacin in comparison with Polish dietary allowances. Improper dietary habits significantly increase the risk of development of cardiovascular diseases, obesity, non-insulin-dependent diabetes, and osteoporosis among the studied subjects.
PMID: 12666449

HUMAN RESEARCH
14. Eur J Clin Nutr. 2002 Nov;56(11):1119-25.
Diet and nutritional status of rural adolescents in India.
Venkaiah K, Damayanti K, Nayak MU, Vijayaraghavan K.
India
In this study the current diet and nutritional status of rural adolescents in India was surveyed in 20 households in 120 villages in each of nine states. Anthropometric and socio-economic

information on 12,124 adolescent boys and girls and dietary information on 2579 individuals in 1996-1997 was used in this analysis. The authors found that the intake of micronutrients such as vitamin A and riboflavin were “woefully inadequate”. CONCLUSIONS: They concluded that the extent of undernutrition was high among all adolescents but higher among boys than girls. The authors also noted that adolescent girls in the rural areas could be at greater risk of nutritional stress because of early marriage and early conception before completion of their physical growth.
PMID: 12428178

HUMAN RESEARCH
15. Age Ageing. 1998 Jul;27(4):455-61.
Nutritional status of elderly Chinese vegetarians.
Woo J, Kwok T, Ho SC, Sham A, Lau E.
UK
This study surveyed the nutritional status of elderly Chinese vegetarians. Dietary recall, anthropometric indices and laboratory tests were assessed in 131 elderly Chinese vegetarian women with a mean age of 81 years. These results were compared with matched omnivores. The authors found that total energy, fat and protein calorie, thiamine, riboflavin and niacin intakes were lower in vegetarians than in non-vegetarians, while carbohydrate calorie, calcium, potassium, retinol equivalent and ascorbic acid intakes were higher. The authors concluded that there was a trade off in the Chinese vegetarian diet. It may be beneficial for avoiding ischaemic heart disease but it is deficient in many B vitamins resulting in a high prevalence of nutritional anemia.
PMID: 9884002

HUMAN RESEARCH
16. Brain Dev. 1997 Jun;19(4):262-7.
Treatment of mitochondrial encephalomyopathy with a combination of cytochrome C and vitamins B1 and B2.
Tanaka J, Nagai T, Arai H, Inui K, Yamanouchi H, Goto Y, Nonaka I, Okada S.
Japan
The authors studied the therapeutic efficacy of a regimen consisting of intravenous injection of Cardiocrome, containing cytochrome c, flavin mononucleotide and thiamine diphosphate for mitochondrial encephalomyopathy (MEM). Nine patients received treatment and eight were improved clinically in the muscle symptoms of easy fatigability, motor disability and severity of stroke-like episodes, as well as in various other symptoms such as phosphate, tinnitus, headache, corneal edema, chilblains, thalamic pain, respiratory failure, and nystagmus. By giving intermittent injections this improvement was maintained for more than 1 year. The authors conclude this therapy was fairly effective for the management of patients with MEM.
PMID: 9187476

HUMAN RESEARCH
17. Brain Dev. 1996 Jan-Feb;18(1):68-70.

Long-term therapy with cytochrome c, flavin mononucleotide and thiamine diphosphate for a patient with Kearns-Sayre syndrome.
Nakagawa E, Osari S, Yamanouchi H, Matsuda H, Goto Y, Nonaka I.
Japan
This is a case report of a patient with Kearns-Sayre syndrome who was treated with Cardiocrome, containing cytochrome c, flavin mononucleotide and thiamine diphosphate, given by IV for 22 months. The authors concluded that this therapy was helpful for impaired skeletal muscle function and corneal edema, but not for ocular movements, central nervous system symptoms or cardiac conduction abnormalities, because irreversible degeneration had probably occurred in these organs before therapy was instituted.
PMID: 8907347

HUMAN RESEARCH
18. J Med Assoc Thai. 1993 Oct;76 Suppl 2:138-45.
Effects of multivitamin supplementation for improvement of thiamin, riboflavin, and retinol nutrition in pediatric patients.
Angkatavanich J, Suthutvoravut U, Panijpan B, Tontisirin K.
Thailand
This study assesses the effect of multivitamin supplementation on thiamin, riboflavin and retinol nutrition in ten chronically ill boys. A multiple vitamin was given for ten days and the preceding ten days served as control. Anthropometric, biochemical, clinical and dietary assessments were performed. Initial biochemical assessments of vitamin nutrition showed multiple vitamin deficiencies yet no clinical manifestations. Most patients showed subclinical vitamin deficiencies. The authors noted that improvement of vitamin nutrition was clearly shown in most patients after supplementation. The authors concluded that multiple vitamin supplements should be routinely prescribed in high-risk patients since there was no definite pattern of vitamin deficiencies in various diseases and early detection of vitamin deficiency was difficult to perform as evidenced by the fact that none of the patients appeared to show any clinical signs of vitamin deficiency. They recommend a daily dosage between 1-2 times of the RDA.
PMID: 7822982

HUMAN RESEARCH
19. Eur J Clin Nutr. 1996 Jul;50 Suppl 2:S77-85.
Longitudinal changes in the intake of vitamins and minerals of elderly Europeans.
SENECA Investigators.
Amorim Cruz JA, Moreiras O, Brzozowska A.
Portugal
This study assessed changes in intake of vitamins and minerals in elderly Europeans. Initially there was a significant decrease in the median intake of vitamin B1, vitamin B2, vitamin B6, vitamin C and iron in several towns. The authors concluded that over the 4-year follow-up period, the proportion of elderly people with nutrient intakes below the lowest European RDI's increased for various nutrients in most towns leaving them at increased risk for malnutrition. The proportion of elderly people taking nutrient supplements varied from less than 5% to 60% in various towns.

HUMAN RESEARCH

20. Trans R Soc Trop Med Hyg. 2003 Jan-Feb;97(1):109-14.

Effects of multimicronutrient supplementation on helminth reinfection: a randomized, controlled trial in Kenyan schoolchildren.

Olsen A, Thiong'o FW, Ouma JH, Mwaniki D, Magnussen P, Michaelsen KF, Friis H, Geissler PW.

Kenya

A randomized, placebo-controlled, double-blind trial was carried out among 977 schoolchildren from 19 primary schools in Nyanza Province, Kenya from February 1995 to February 1996 to determine effects on worm infestation. The treatments included vitamin A and are as follows:(vitamin A, 1000 micrograms; vitamin B1, 1.4 mg; vitamin B2, 1.6 mg; vitamin B6, 1.7 mg; vitamin B12, 2.0 micrograms; folate, 150 micrograms; niacin, 16 mg; vitamin C, 50 mg; vitamin D, 5 micrograms; vitamin E, 8 mg; iron, 18 mg; zinc, 20 mg; copper, 2.0 mg; iodine, 150 micrograms; selenium, 40 micrograms) and multihelminth chemotherapy (albendazole 600 mg in a single dose and/or praziquantel 40 mg/kg in a single dose). Children given multimicronutrients had a slightly, but significantly, lower intensity of Schistosoma mansoni reinfection compared with children given placebo.

HUMAN RESEARCH

21. Arterioscler Thromb Vasc Biol. 2002 Mar 1;22(3):488-91.

Total homocysteine lowering treatment among coronary artery disease patients in the era of folic acid-fortified cereal grain flour.

Bostom AG, Jacques PF, Liaugaudas G, Rogers G, Rosenberg IH, Selhub J.

USA

The authors acknowledge that plasma homocysteine has been reduced in the population since the fortification of flour products with folic acid. This study was designed to evaluate higher doses of folic acid along with riboflavin, and with or without vitamin B6 for 12 weeks in 131 coronary artery disease (CAD) patients. The authors concluded that CAD patients already eating fortified cereal grain flour products given high-dose, folic acid, riboflavin and vitamin B6 have a very modest reduction in their homocysteine levels.

PMID: 11884295

HUMAN RESEARCH

22. Vopr Pitan. 2001;70(1):12-4.

Effects of biologically active supplements on the antioxidant and vitamin status of patients with hypertension and ischemic heart disease.

Tutel'ian VA, Pogozheva AV, Rumiantseva OI, Akol'zina SE, Lysikova SL, Kodentsova VM, Mal'tsev GIu.

Russia

In this study patients of 91 patients with heart disease were treated with an anti-arteriosclerotic diet and vitamins C, E, B2, B6, beta-carotene, zinc, magnesium, sodium, potassium, and calcium. After 4 weeks the author noted improvement in clinical symptoms, lowering of serum

cholesterol, triglycerides and increasing levels of of vitamins A, E, C, B2, and B6.
PMID: 11338339

23. Am J Clin Nutr. 2000 Jun;71(6 Suppl):1676S-81S.
Nutritionally induced oxidative stress: effect on viral disease.
Beck MA.
USA
The authors review research that proves nutritional status of the host can influence both susceptibility to infectious disease and the severity of the disease if contracted. They theorize that if the nutritional status of the host is weakened a normally avirulent virus becomes virulent because of changes in the viral genome. The authors conclude that outbreaks of disease may be erroneously attributed to a nutritional deficiency but may be the result of infection by a virus that has become pathogenic by replicating in a nutritionally deficient host.
PMID: 10837315

HUMAN RESEARCH
24. N Z Med J. 1996 Nov 22;109(1034):435-8.
Nutrient intakes of Tongan and Tokelauan children living in New Zealand.
Bell AC, Parnell WR.
New Zealand
The authors, using a 24-hour diet record, wanted to measure the nutrient intakes of 10- to 13-year-old Tongan and Tokelauan children living in New Zealand and to compare them with non-Pacific Islands children of the same age. A total of 162 children (68 boys and 94 girls) were interviewed. Micronutrient intakes were generally lower for Tongan and Tokelauan children with intakes of calcium, riboflavin, thiamin, niacin, folate and vitamin A being significantly lower for both sexes. Vitamin C was also significantly lower for girls ($p < 0.05$).
The reason for the deficiencies in Tongan and Tokelauan children were that they obtain most of their nutrients from meat, bakery products, fast foods and dairy products. Fruit and vegetables were not significant in their diet.
PMID: 8982173

HUMAN RESEARCH
25. J Am Diet Assoc. 1995 Dec;95(12):1409-13.
High-risk nutrient intakes among low-income Mexican women in Chicago, Illinois.
Ballew C, Sugerman SB.
USA
The authors report on data from The Cross-sectional Cooking, Eating, Nutrition, and Shopping (CENAS) Survey for food consumption patterns of 186 low-income Mexicans living in Chicago, Ill. The micronutrient intake was 11% of the RDA for thiamin and riboflavin and a high of 82% of the RDA for folacin.
PMID: 7594143

HUMAN RESEARCH

26. Biochem Biophys Res Commun. 1995 Jul 6;212(1):35-40.

Myocardial flavin reductase and riboflavin: a potential role in decreasing reoxygenation injury.

Mack CP, Hultquist DE, Shlafer M.

Department of Pharmacology, University of Michigan Medical School, Ann Arbor 48109, **USA.**

Ferrylmyoglobin damages cardiac muscle after ischemic attacks. However, an enzyme, flavin reductase, which works more efficiently with more flavins, can reduce the levels of ferrylmyoglobin. The authors found that treating with riboflavin has cardioprotective effects during reoxygenation and that these effects are mediated by flavin reductase.

PMID: 7612015

HUMAN RESEARCH

27. J Am Coll Nutr. 1995 Feb;14(1):71-9.

The important role of modifiable dietary and behavioral characteristics in the causation and prevention of coronary heart disease hospitalization and mortality: the prospective NHANES I follow-up study.

Gartside PS, Glueck CJ.

USA

In this 10-year study 8,251 subjects in the National Health and Nutrition Examination Survey, NHANES I, were assessed for modifiable dietary and behavioral characteristics in association with coronary heart disease (CHD). After ten years 492 people had cardiovascular events. The authors found that the following factors were independently, significantly, and inversely associated with coronary heart and vascular disease deaths and hospitalizations: alcohol intake, dietary riboflavin, dietary iron, serum magnesium, leisure time exercise, habitual physical activity, and female gender. They concluded that there are important modifiable dietary and behavioral characteristics in the causation and prevention of CHD.

PMID: 7706615

HUMAN RESEARCH

28. Presse Med. 1994 Oct 22;23(32):1475-9.

Hypertrophic cardiomyopathy caused by cytochrome-oxidase deficiency

Gournay-Toulemonde V, Munnich A, Bouhour JB, Lefevre M, Potiron M, Saudubray JM.

Paris

This is a case report of a 16-year-old girl who had cytochrome C oxidase deficiency. The diagnosis was confirmed by spectrophotometric and polarographic assay of mitochondria from a peripheral muscle biopsy. Treatment with riboflavin, ascorbic acid, factor P, menadione, carnitine and iron sulfate has lead to some clinical improvement.

PMID: 7824467

HUMAN RESEARCH

29. Biochem Mol Biol Int. 1994 Oct;34(4):685-91.

Protective effects of riboflavin and its derivatives against ischemic reperfused damage of rat heart.
Kotegawa M, Sugiyama M, Haramaki N.
Japan
This study measured the ability of riboflavin derivatives to help recovery of reperfused rat hearts. The authors found that in all the hearts perfused with riboflavin and its derivatives during ischemia-reperfusion, a marked recovery of high energy phosphate compounds and pH values were observed. There was an additional effect in that the cardiac mitochondrial respiratory function was protected from ischemia-reperfusion injury. The authors conclude that their results suggest that riboflavin, FAD, FMN, and lumichrome have a protective effect against ischemia-reperfusion injury to rat myocardium in vitro.
PMID: 7866293

HUMAN RESEARCH
30. Vopr Med Khim. 1994 Mar-Apr;40(2):41-5.
B group vitamin metabolism in duodenal ulcer disease, hypertension, and ischemic heart disease
Kodentsova VM, Vrzhesinskaia OA, Kharitonchik LA, Spirichev VB.
Russia
In a study on B vitamin metabolism, no differences were found in the rate of metabolism of vitamins B1, B2, B6 and niacin either in healthy persons or in patients with duodenal ulcer, hypertension, and ischemic heart disease as shown in laboratory excretion patterns. However, riboflavin deficiency caused considerable impairments of vitamin B6 and niacin metabolism.
PMID: 8160430

HUMAN RESEARCH
31. Nutr Rev. 1993 May;51(5):149-50.
Riboflavin can protect tissue from oxidative injury.
Christensen HN.
USA
The author found that elevated riboflavin levels have been reported to provide protection against oxidative damage caused by oxidized forms of hemeproteins (iron proteins). This effect of riboflavin may be mediated by an NADPH-dependent methemoglobin reductase.
PMID: 8332286

HUMAN RESEARCH
32. Br J Nutr. 1992 Jul;68(1):11-9.
Diet among oil-workers on off-shore oil installations in the Norwegian sector of the North Sea.
Oshaug A, Ostgard LI, Trygg KU.
Norway
A study of diet on oil rigs showed that 17% came from protein, 44% from fat and 39% from carbohydrate, including 8% from sugar. Meat, vegetables, fresh fruits, seafood (shellfish), french

fries, eggs, cream and ice-cream were important components of the diet, while bread, fish and cereals played a minor role. Average daily intake (mg) of nutrients were: calcium 1244, iron 15, vitamin A 1049 micrograms, vitamin D 4.1 micrograms, thiamin 1.6, riboflavin 2.2, nicotinic acid 22, ascorbic acid 143. Dietary fiber intake was on average 19 g, and the average daily intake of cholesterol was 755 mg. The authors concluded that this type of diet if eaten chronically may contribute to the development of coronary heart diseases (CHD) and thereby increase the morbidity and mortality from CHD in the oil industry.
PMID: 1390597

HUMAN RESEARCH
33. J Epidemiol Community Health. 1991 Jun;45(2):148-51
Relation between diet composition and coronary heart disease risk factors.
Porrini M, Simonetti P, Testolin G, Roggi C, Laddomada MS, Tenconi MT.
Italy
This study evaluated diet and risk factors for coronary heart disease. Dietary evaluation and blood tests were done on adults living in a small town in Northern Italy. The hypercholesterolaemic and atherogenic potential of the diet, evaluated by the cholesterol/saturated fat index, was high in about 50% of the population. The thiamin and riboflavin intakes were lower than the Italian recommended allowances in more than 60% of the people tested.
PMID: 1649247

HUMAN RESEARCH
34. Atherosclerosis. 1989 Jan;75(1):1-6.
Reduction of plasma lipid and homocysteine levels by pyridoxine, folate, cobalamin, choline, riboflavin, and troxerutin in atherosclerosis.
Olszewski AJ, Szostak WB, Bialkowska M, Rudnicki S, McCully KS.
USA
The level of homocysteine was correlated with nutrient treatment in 12 male survivors of acute myocardial infarction. They were given pyridoxine, folate, cobalamin, choline, riboflavin, and troxerutin for 21 days. The plasma concentrations of homocysteine and alpha-amino adipic acid declined to 68% and 57% of the pretreatment values, and the cholesterol, triglycerides, and LDL apo B declined to 79%, 68%, and 63% of the pretreatment values, respectively. The authors conclude that their results suggest a new strategy for treating the metabolic abnormalities in atherosclerosis through the use of naturally occurring, non-toxic nutrients which minimize homocysteine accumulation.
PMID: 2930611

HUMAN RESEARCH
35. Vopr Med Khim. 1988 Sep-Oct;34(5):99-104.
Effect of therapy with beta-adrenoblockers and vitamin complexes on indices of oxyproline excretion in various hereditary connective tissue diseases
Prozorovskaia NN, Glinianaia SV, Gerashchenko LP, Rudakov SS, Solonichenko VG.

Russia
In this study 16 children with with Marphan-Like syndrome and Marphan, Ehlers-Dunlos and Larson syndromes were treated with propranolol and a complex of vitamins (ascorbic acid, riboflavin and pyridoxine). The authors noted that treatment caused quantitative and qualitative correction of collagen and apparently of elastin fibrilles development. The authors feel that their complex treatment might be applied as a preoperative therapy of the patients with Marphan-like syndrome as well as with syndromes of Marphan and Ehlers-Dunlos before thoracoplastics for chest deformation.
PMID: 2905846

ANIMAL RESEARCH
36. Cancer. 1986 Oct 15;58(8 Suppl):1911-4.
New approaches to the possible prevention of side effects of chemotherapy by nutrition.
Pinto J, Raiczyk GB, Huang YP, Rivlin RS.
The authors wanted to determine to what extent Adriamycin inhibits the metabolism of riboflavin. Adriamycin forms complexes riboflavin and competes for binding to tissue proteins. The study found that rats treated with Adriamycin exhibited diminished formation of flavin adenine dinucleotide (FAD), the active flavin coenzyme derivative, in skeletal muscle to nearly 50% that of controls, and in heart to about 70% to 80% of controls. The authors note that in preliminary studies, riboflavin-deficient animals treated with Adriamycin had accelerated mortality rates. Their results raise the possibility that defects of riboflavin nutriture, may be a determinant of Adriamycin toxicity. The authors conclude that further studies are required to explore the potential for preventing side effects due to Adriamycin by giving riboflavin.
PMID: 3756811

ANIMAL RESEARCH
37. Farmakol Toksikol. 1984 Nov-Dec;47(6):46-50.
Action of a vitamin complex with oxidative-reductive properties on the course of acute myocardial hypoxia and ischemia.
Sidorenko AF, Gatsura VV.
Russia
The authors acknowledge that certain vitamins (ascorbic acid, riboflavine mononucleotide, lipoic acid, nicotinamide) treat experimental hypoxia in mice. The same complex of vitamins reduced metabolic acidosis in the ischemia zone in dogs. This protective action of the vitamins, also seen in myocardial ischemia, is due to conjugation of oxidation and phosphorylation in the mitochondria of the ischemic myocardium, as well as with its membrane-stabilizing action and inhibition of lipid peroxidation.
PMID: 6240410

ANIMAL RESEARCH
38. J Electrocardiol. 1981 Jul;14(3):219-24.
Mechanism of chlorpromazine-induced arrhythmia -- arrhythmia and mitochondrial dysfunction.

Kitazawa M, Sugiyama S, Ozawa T, Miyazaki Y, Kotaka K.
Japan
In this study of the mechanism of the arrhythmogenic action of chlorpromazine (CPZ) was observed in 32 anesthetized mongrel dogs were used. Flavin-adenine-dinucleotide was given along with the CTZ and prevented not only the decrease in ventricular multiple response threshold (VMRT) and the disturbance of mitochondrial function, but also the hypotensive effect of CPZ.
PMID: 6167651

ANIMAL RESEARCH
39. Jpn Heart J. 1979 Sep;20(5):657-65.
Protection of chlorpromazine-induced arrhythmia by flavin-adenine-dinucleotide in canine heart.
Sugiyama S, Ozawa T.
Japan
This study, to investigate the mechanism of chlorpromazine(CPZ)-induced ventricular arrhythmia, the changes in ventricular fibrillation threshold (VFT) were followed after intravenous injection of CPZ in dogs. When flavin-adenine-dinucleotide (FAD) was given before the CPZ, VFT was significantly cancelled. Effects of CPZ on canine heart mitochondria were also cancelled by prior administration of FAD. The authors conclude that their results suggest that FAD might be useful in the treatment of the cardiac disturbances associated with overdosage of CPZ.
PMID: 501931

HUMAN RESEARCH
40. Am Heart J. 1976 Aug;92(2):139-43.
Riboflavin deficiency in infants and children with heart disease.
Steier M, Lopez R, Cooperman JM.
USA
In an effort to determine if children with heart disease have riboflavin deficiency 31 children were tested. Twenty-seven children had congenital heart disease and four had rheumatic heart disease. Eleven of the 31 children had evidence of riboflavin deficiency, which is a significantly higher prevalence than among the control group. Those children with congestive heart failure were more likely to have riboflavin deficiency. The authors conclude that nutritional deficiencies may be more prevalent among infants and children with cardiac disease than was previously thought.
PMID: 941824

ANIMAL RESEARCH
41. Osteoarthritis Cartilage. 2002 Feb;10(2):119-26.
Dietary vitamins and selenium diminish the development of mechanically induced osteoarthritis and increase the expression of antioxidative enzymes in the knee joint of STR/1N mice.

Kurz B, Jost B, Schunke M.
Germany
This study assessed the effect of dietary vitamins and selenium on mechanically-induced osteoarthritis (OA) over a 12 month period in a group of mice. Their special diet was supplemented with the vitamins E, C, A, B6, B2, and selenium). The authors found that a diet supplemented with vitamins/selenium might be important in prevention or therapy of mechanically induced OA. They hypothesize that free oxygen radical species might be involved in the mechanical induction of OA.
PMID: 11869071

HUMAN RESEARCH
42. Ann Rheum Dis. 1996 Nov;55(11):837-40.
Glutathione reductase activity, riboflavin status, and disease activity in rheumatoid arthritis.
Mulherin DM, Thurnham DI, Situnayake RD.
UK
This study set out to measure erythrocyte glutathione reductase (EGR) activity and riboflavin status, and their association with rheumatoid arthritis. Riboflavin is required by EGR for it to work. Participants in the study were 91 patients with rheumatoid arthritis, including 57 with active disease, and 220 healthy control. Both basal and stimulated EGR were significantly higher in patients with rheumatoid arthritis than in controls. Biochemical riboflavin deficiency was identified in 41% controls and 33% patients with active rheumatoid arthritis but was significantly less frequent (9%) in patients with inactive compared to active disease or healthy controls. Pain score, articular index, C reactive protein, and erythrocyte sedimentation rate were increased in patients with riboflavin deficiency. The authors concluded that higher basal and stimulated EGR might be expected in patients with rheumatoid arthritis in response to chronic oxidative stress due to synovial inflammation. The association of riboflavin deficiency with increased disease activity implies that impaired EGR activity could facilitate ongoing inflammation.
PMID: 8976642

ANIMAL RESEARCH
43. Z Rheumatol. 1988 May-Jun;47(3):166-72.
Effect of riboflavin (vitamin B2) on spontaneous gonarthrosis in the mouse
Wilhelmi G, Tanner K.
Switzerland
The authors acknowledge that riboflavin is known to promote regenerative processes on osteoarthritis. In this study a group of mice given supplemental riboflavin. The incidence of gonarthrosis was less than half that found in the controls, the number of mice with bilateral gonarthrosis was considerably smaller, and the severity of the lesions less marked. Other drugs that stimulate wound healing were studied e.g. flavonoids, tribenoside, and zinc sulfate. These substances were also found to exert a similar inhibitory effect on spontaneous gonarthrosis in the mouse.
PMID: 3213264

ANIMAL RESEARCH

44. Farmakol Toksikol. 1988 Mar-Apr;51(2):69-71.

Influence of enzyme inducers and inhibitors of the metabolism of xenobiotics and of the coenzyme forms of vitamins B1 and B2 on the anti-inflammatory effect of voltaren.

Stanislavchuk NA, Pentiuk AA, Lychik GZ, Lychko AP, Lutsiuk NB.

Russia

In experiments on 245 male rats the effect of vitamins B1 and B2, thiamine diphosphate and flavin mononucleotide on the anti-inflammatory effect of voltaren was evaluated. The authors found that thiamine diphosphate potentiates the therapeutic effect of voltaren. And flavin mononucleotide decreases volatren's toxicity.

PMID: 3259936

HUMAN RESEARCH

45. Med Monatsschr Pharm. 1991 Aug;14(8):244-7.

Folic acid and vitamin deficiency caused by oral contraceptives

Bielenberg J.

The authors acknowledge recent reports that long-term use of estrogen-containing oral contraceptives (OCs) can induce folic acid and vitamin B deficiency. The symptoms are paleness, forgetfulness, sleeplessness, and euphoric and depressive states. Vitamin B12 deficiency as well as lower riboflavin and thiamin concentration in erythrocytes is reported after using OCs. The author recommended patient education on the effects of vitamin deficiency and on proper nutrition for women on Ocs as well as estrogen replacement therapy.

PMID: 1921842

HUMAN RESEARCH

46. Int J Epidemiol. 1998 Oct;27(5):845-52.

Nutritional factors in the aetiology of multiple sclerosis: a case-control study in Montreal, Canada.

Ghadirian P, Jain M, Ducic S, Shatenstein B, Morisset R.

Canada

The authors acknowledge that nutrition and food patterns, particularly high consumption of animal fat and low intake of fish products, may play a role in the aetiology of multiple sclerosis (MS). The association between nutritional factors and MS was studied among 197 incident cases and 202 frequency matched controls. A significant protective effect was observed with vegetable protein, dietary fiber, cereal fiber, vitamin C, thiamin, riboflavin, calcium, and potassium. Similar trends were seen for males and females. A higher intake of fruit juices was inversely associated with risk. A protective effect was also observed with cereal/breads intake for all cases combined and for fish among women only; pork/hot dogs and sweets/candy were positively associated with risk. The authors conclude that this study supports a protective role for plants foods (fruit/vegetables and grains) and an increased risk with high energy and animal food intake.

PMID: 9839742

HUMAN RESEARCH

47. Nutr Hosp. 2002 Nov-Dec;17(6):290-5.

Anthropometric assessment and vitamin intake by a group of elderly institucionalized individuals in the province of Leon (Spain)

Villarino Rodriguez A, Garcia-Linares Mdel C, Garcia-Arias MT, Garcia-Fernandez Mdel C.

Spain

This is a survey of nutritional deficiencies of micronutrients in 124 elderly persons (60 males and 64 females), aged between 65 and 98, who were living in five old age institutions. Inadequate levels of folic acid, vitamin A, riboflavin and vitamin B12 were found in important segments of this population. Even lower results were found in vitamin B6, vitamin D and vitamin E). Compared to recommended values the results were: (93.5% vs 67.8% for vitamin B6, 84.5% vs 84.6% for vitamin D, and 88.3% vs 92.2% for vitamin E, for men and women, respectively).

PMID: 12514922

HUMAN RESEARCH

48. Ann Thorac Surg. 2002 Oct;74(4):1251-2.

Type B lactic acidosis: a rare complication of antiretroviral therapy after cardiac surgery.

Vasseur BG, Kawanishi H, Shah N, Anderson ML.

USA

This is a case report of a 47-year-old woman with HIV and end-stage renal disease on hemodialysis, treated with combination antiretroviral drug therapy, who developed an acute, severe lactic acidosis 24 hours after surgery for endocarditis. She fully recovered after HIV medication was discontinued, along with administration of riboflavin and supportive measures including hemodialysis. The authors suggest that the timing of this complication and previous reports implies that open heart surgery may be a risk factor for nonischemic (type B) lactic acidosis in patients taking nucleoside analogue reverse transcriptase inhibitors.

PMID: 12400787

HUMAN RESEARCH

49. Epilepsy Res. 2002 Oct;51(3):237-47.

The effect of B-vitamins on hyperhomocysteinemia in patients on antiepileptic drugs.

Apeland T, Mansoor MA, Pentieva K, McNulty H, Seljeflot I, Strandjord RE.

Norway

The authors acknowledge that patients on antiepileptic drugs (AEDs) may have elevated levels of plasma total homocysteine (p-tHcy). This study was designed to assess the effect of B-vitamin supplementation on the levels of p-tHcy and markers of endothelial activation and lipid peroxidation. A total of 33 adult patients were recruited and supplemented with B-vitamins for 30 days: folic acid 0.4 mg, pyridoxine 120 mg and riboflavin 75 mg per day. The authors concluded that the combined supplementation with folic acid, pyridoxine and riboflavin reduced fasting and PML hyperhomocysteinemia in patients on AEDs. They also note that B-vitamin

supplementation influenced endothelial activation, although the clinical implication is uncertain.
PMID: 12399074

HUMAN RESEARCH
50. Eur J Clin Nutr. 2002 Oct;56(10):1004-10.
Validation of the Italian food composition database of the European institute of oncology.
Fidanza F, Perriello G.
Italy
This survey compared nutrient intakes obtained by chemical analysis of food composite or duplicate portion of diets with those obtained by weighed record method using the database of the European Institute of Oncology (EIO). The authors found significant differences between analysis and calculation with EIO database for fat, retinol, beta-carotene and riboflavin intakes in different areas of Italy. They agreed with previous research and concluded that food composition tables and databases, such as the EIO database, cannot be considered a reliable method to determine nutrient intakes, particularly for some vitamins.
PMID: 12373621

HUMAN RESEARCH
51. Paediatr Child Health. 2002 Oct;38(5):450-37.
Anti-oxidant vitamins and steroid responsive nephrotic syndrome in Indian children.
Mathew JL, Kabi BC, Rath B.
India
The authors acknowledge that nephrotic syndrome may be a consequence of an imbalance between oxidant and anti-oxidant activity. In the present study, the levels of micronutrient anti-oxidant vitamins (vitamin E, vitamin C, carotene and riboflavin) in 30 Indian children with steroid responsive nephrotic syndrome were investigated and 30 sibling controls. The authors found that mean vitamin E, vitamin C and carotene were significantly lower during the proteinuric phase of the disease, and there was decreased erythrocyte riboflavin activity. The vitamin levels improved during hospitalization but did not become normal. The authors concluded that these vitamins were active in performing their anti-oxidant function, as indicated by significant depression in their levels during the acute (proteinuric) phase, followed by partial recovery during remission. They conclude that steroid responsive nephrotic syndrome in children is associated with oxidative stress.
PMID: 12354259

HUMAN RESEARCH
52. J Health Popul Nutr. 2002 Sep;20(3):255-63.
Food habits and nutrient density of diets of Pakistani children living in different urban and rural settings.
Hakeem R, Thomas J, Badruddin SH.
UK/Pakistan
This study analyzed three-day food records for the food habits and nutrient density of diets of six groups of rural and urban school children aged 10-12 years. The results were that with

urbanization, the intake of fat and sugar increased steadily. The intake of carbohydrate, fiber, riboflavin, and vitamin E decreased with urbanization.
PMID: 12430763

HUMAN RESEARCH
53. J Nutr. 2003 Jun;133(6):1834-40.
A multinutrient-fortified beverage enhances the nutritional status of children in Botswana.
Abrams SA, Mushi A, Hilmers DC, Griffin IJ, Davila P, Allen L.
USA/Botswana
The authors acknowledge that multinutrient-fortified foods and beverages may be useful in reducing micronutrient deficiencies, especially in developing countries. This study assessed a new fortified beverage in improving nutritional status of a group of 311 lower income urban school children, ages 6-11 years. The changes in mid-upper arm circumference, weight for age and total weight, ferritin, riboflavin and folate status were significantly better in the fortified group. The authors conclude that a micronutrient-fortified beverage may be beneficial as part of a comprehensive nutritional supplementation program in populations at risk for micronutrient deficiencies.
PMID: 12771326

ANIMAL RESEARCH
54. Br J Nutr. 2002 May;87(5):501-8.
Effect of multivitamins in an effervescent preparation on the respiratory burst of peritoneal macrophages in mice.
Jakus J, Kriska T, Vanyur R.
Hungary
In a group of mice multivitamin supplementation with or without alpha-tocopherol, ascorbic acid, riboflavin increased macrophages activity, lowered the steady-state free radical concentrations of liver and spleen, increased the antioxidant reactivity of the liver and spleen, and had a general beneficial effect on the defense mechanisms of the organism.
PMID: 12010588

HUMAN RESEARCH
55. J Med Assoc Thai. 1998 Dec;81(12):931-7.
Thiamin and riboflavin status of medical inpatients.
Songchitsomboon S, Komindr S, Kulapongse S, Puchaiwatananon O, Udomsubpayakul U.
Thailand
This paper assesses thiamin and riboflavin status was assessed in 165 medical inpatients. The patients were receiving thiamine and riboflavin in their diets. Nine per cent of the medical inpatients had thiamin depletion. Seventeen per cent had riboflavin depletion. The authors concluded that although the usual dose of vitamin supplementation in medical inpatients is beneficial vitamin depletion can still be present in catabolic patients.
PMID: 9916379

HUMAN RESEARCH

56. Biol Trace Elem Res. 1998 Nov;65(2):109-15.

Effect of riboflavin supplementation on zinc and iron absorption and growth performance in mice.

Agte VV, Paknikar KM, Chiplonkar SA.

India

The authors acknowledge that vegetarian diets high in rice and whole grains and low in yellow vegetables are deficiency in riboflavin. Such diets also allow poor bioavailability of insoluble iron and zinc. It is known that supplementation of riboflavin may result in increased absorption of zinc and iron. In mice given riboflavin there was significant improvement in the growth ie., conception, mean weight gain in pregnancy, mean weight of pups at the age of 21 days, and percentage hemoglobin. Riboflavin supplementation also enhanced the absorption of zinc..

PMID: 9881515

HUMAN RESEARCH

57. Eur J Clin Nutr. 1991 Jun;45(6):309-13.

Enzymatic evaluation of riboflavin status of infants.

Bamji MS, Chowdhury N, Ramalakshmi BA, Jacob CM.

India

Two studies measured riboflavin status of solely breast-fed (SBF) infants aged 1-6 months and solely or partially breast-fed (PBF) and weaned infants aged 6-24 months. Riboflavin status of the infants was significantly superior to that of their mothers. However, 35 per cent of SBF infants examined suffered from biochemical riboflavin deficiency. In a paper in progress the authors compared the riboflavin status of 55 solely breast fed (SBF) 1-6 month old infants with 112 (SBF), partially breast fed, or weaned 6-24 month old infants from low income families in India. The authors found that the beneficial effects of supplementary feeding on riboflavin status in 6-8 month old infants was the most significant finding. Scientists suspect that riboflavin deficiency affects psychomotor functions and impairs collagen maturity and wound healing.

PMID: 1915204

HUMAN RESEARCH

58. Eur J Clin Nutr. 1988 Apr;42(4):277-83.

Riboflavin deficiency and severity of malaria.

Das BS, Das DB, Satpathy RN, Patnaik JK, Bose TK.

India

In an assessment of the riboflavin status of 64 children suffering from malarial infection the lower the riboflavin levels the slower the recovery time. however, parasite count was not lower in those who had higher riboflavin. The authors conclude that the beneficial effects of riboflavin in malaria infection needs further evaluation.

PMID: 3293996

HUMAN RESEARCH

59. Arch Latinoam Nutr. 1984 Dec;34(4):615-29.

Food consumption and dietary adequacy according to income in 1,200 families, Manaus, Amazonas, Brazil, 1973-1974.
Shrimpton R.
Data from a household expenditure survey of 1,200 Manaus families performed by the Amazonas State Government in 1973-74 are analyzed by income group. In terms of nutrients the most deficient were zinc, vitamin A, calcium, thiamine and riboflavin, with 60-80% of low and middle income families not receiving safe levels of intake for zinc and vitamin A. A higher income improved the adequacy of calcium, thiamine and riboflavin intake and was quantitative. Zinc and vitamin A, improved in the increased income group due to increased consumption of meat and liver.
PMID: 6545643

HUMAN RESEARCH
60. Hum Nutr Clin Nutr. 1983 Dec;37(6):427-32.
Efficacy of a riboflavin supplement given at fortnightly intervals to pregnant and lactating women in rural Gambia.
Bates CJ, Flewitt A, Prentice AM, Lamb WH, Whitehead RG.
Thirty-seven pregnant or lactating women living in two rural villages, received 15 mg riboflavin, or a placebo, at fortnightly intervals for 10 weeks. Clinical status and blood levels were monitored. The authors found that biochemical deficiency was very marked at the outset, and showed some improvement after supplementation, but never reached normal. They concluded that a riboflavin supplement given at spaced intervals can be clinically beneficial, despite failure to achieve normal biochemical indices.
PMID: 6365849

HUMAN RESEARCH
61. Aust N Z J Public Health. 1997 Apr;21(2):141-6.
Dietary intake of Australian smokers and nonsmokers.
English RM, Najman JM, Bennett SA.
Australia
This study surveys smokers (1024 men and 785 women) and nonsmokers (1974 men and 2421 women). The results were that both men and women, nonsmokers had a significantly higher intake of starch, dietary fibre (g/day and g/1000 kJ), thiamin, vitamin C, calcium and magnesium than smokers, who also had a significantly higher intake of alcohol. Male smokers also have a higher intake of energy and cholesterol, but a lower intake of riboflavin, than nonsmokers. These differences in nutrient intakes suggest that nonsmokers consume a more nutritious diet than smokers, in regard to having a higher intake of fruit and vegetables, wholegrain cereals and milk and milk products. There is a highly statistically significant association between smoking status and hazardous intake of alcohol. Both men and women who smoke have a significantly lower body mass index (BMI), than nonsmokers or ex-smokers.

HUMAN RESEARCH
62. Vopr Med Khim. 1999 Mar-Apr;45(2):150-7.

Metabolism of vitamins B1 and B2 during phenylketonuria
Kodentsova VM, Vrzhesinskaia OA, Denisova SN, Spirichev VB.
Russia
In phenylketonuris (PKU) children there is increased riboflavin urinary excretion. The authors discuss the necessity for the redetermination of vitamin B2 diet and the optimal content with this disease and its biochemical validation.

HUMAN RESEARCH
63. J Hum Nutr Diet. 2001 Oct;14(5):365-70.
Riboflavin deficiency in cystic fibrosis: three case reports.
McCabe H.
UK
This is a case report on three cystic fibrosis children with clinical riboflavin deficiency. The children presented w angular stomatitis and riboflavin deficiency was confirmed by blood testing. The authors found that they were not on riboflavin supplements and were given a water-soluble vitamin complex. Two children were adequately nourished which implies their deficiency was due to either increased requirements, inadequate absorption or utilization. Further testing showed deficiencies in thiamin, pyridoxine. The authors conclude that they have found vitamin deficiencies not previously reported in the cystic fibrosis population.

HUMAN RESEARCH
64. Eur J Clin Nutr. 2003 Aug;57(8):947-55.
Dietary intakes and lifestyle factors of a vegan population in Germany: results from the German Vegan Study.
Waldmann A, Koschizke JW, Leitzmann C, Hahn A.
Germany
Evaluation was done on the diet of 154 vegans using two 9-day food frequency questionnaires and blood sampling. The authors concluded that to achieve favourable vitamin and mineral intakes, vegans should consider taking supplements containing riboflavin, cobalamin, calcium, and iodine.

HUMAN RESEARCH
65. J Am Diet Assoc. 2003 Aug;103(8):1029-38.
Nutritional cofactor treatment in mitochondrial disorders.
Marriage B, Clandinin MT, Glerum DM.
Canada
This literature review on nutritional cofactor therapy in mitochondrial disorders, the goal being to increase mitochondrial adenosine 5'-triphosphate production and slow or arrest the progression of clinical symptoms. Because of toxic metabolites and reduced electron transfer activity much attention is on the use of antioxidants, electron transfer mediators (which bypass the defective site), and enzyme cofactors. Evidence shows that positive effects have come from metabolic therapies such as: Coenzyme Q(10) (ubiquinone); antioxidants such as ascorbic acid, vitamin E,

and lipoic acid; riboflavin; thiamin; niacin; vitamin K (phylloquinone and menadione); creatine; and carnitine.

HUMAN RESEARCH
66. J Viral Hepat. 2003 Jul;10(4):266-70.
Liver p53 expression in patients with HCV-related chronic hepatitis.
Loguercio C, Cuomo A, Tuccillo C, Gazzerro P, Cioffi M, Molinari AM, Del Vecchio Blanco C.
Italy
The authors studied a mutated p53 cancer gene to see what affected it's expression in patients with liver cancer and hepatitic C virus. Diet history documented that liver samples from patients with a p53 over-expression had a lower intake of total calories, monounsaturated fatty acids, vitamin C and riboflavin than normal. The author concluded that p53 over-expression can occur even in initial stages of HCV-related liver disease and may be prompted by subnormal nutrition.

HUMAN RESEARCH
67. Am J Clin Nutr. 2003 Jun;77(6):1352-60.
Riboflavin (vitamin B-2) and health.
Powers HJ.
UK
The author reviews the literature on riboflavin nutrition. Riboflavin is found in milk and dairy products, meat and fish and certain fruit and vegetables, especially dark-green vegetables. Biochemical signs of depletion arise within only a few days of dietary deprivation. Poor riboflavin status in Western countries mainly affects the elderly and adolescents. However, requirements may be higher than previously thought or biochemical thresholds for deficiency are inappropriate. Poor riboflavin status interferes with iron handling, may be a risk factor for cancer, lowers homocysteine, a risk factor for cardiovascular disease, may protects again ischemia reperfusion injury, and may reduce the metabolism of other B vitamins, especially folate and vitamin B-6.

ANIMAL RESEARCH
68. Dig Dis Sci. 2003 Jun;48(6):1159-64.
Absence of luminal riboflavin disturbs early postnatal development of the gastrointestinal tract.
Yates CA, Evans GS, Pearson T, Powers HJ.
UK
In this rat study the absence of riboflavin in the duodenal lumen impairs normal development, suggesting that the normal crypt development sensing mechanism may be involved in the response to riboflavin deficiency.

BASIC RESEARCH
69. Int J Oncol. 2003 Jun;22(6):1291-5.

Augmentation of the inhibitory effect of blue light on the growth of B16 melanoma cells by riboflavin.
Ohara M, Fujikura T, Fujiwara H.
Japan
In a study on the anticancer effects of blue light in association with vitamins, B16 melanoma cells were incubated in media supplemented with various vitamins and exposed to blue light for 10 min. Cell necrosis was observed in media containing riboflavin and the effects increased with increasing amounts of the vitamin. The authors concluded that cell necrosis is probably induced by active oxygen species such as hydrogen peroxide formed by the reaction of riboflavin with blue light.

HUMAN RESEARCH
70. Int J Cancer. 1998 Nov 9;78(4):415-20.
Nutrient intake patterns and gastric cancer risk: a case-control study in Belgium.
Kaaks R, Tuyns AJ, Haelterman M, Riboli E.
France.
Dietary assessments were undertaken on 301 Belgian men and women with stomach tumors. Those at increase risk had a diet rich in mono- and disaccharides. Those with low gastric cancer risk had high intake of vitamin C, beta-carotene, vitamins B1, B3 and B6. These findings were consistent with those of colon and rectum cancer studies.

HUMAN RESEARCH
71. Arch Ophthalmol. 2001 Jul;119(7):1009-19.
Long-term nutrient intake and early age-related nuclear lens opacities.
Jacques PF, Chylack LT Jr, Hankinson SE, Khu PM, Rogers G, Friend J, Tung W, Wolfe JK, Padhye N, Willett WC, Taylor A.
USA.
Nuclear lens opacities, associated with the development of cataracts were measured in 478 nondiabetic women aged 53-73. Information about nutrition and vitamin supplementation was gathered over 13-15 years of the study. The finding indicated that those with the highest nutrient rating (vitamin C, vitamin E, riboflavin, folate, beta-carotene) had the lowest incidence of nuclear opacities.