

## Health Economical Benefits of Optimum Nutrition

**Milly Ryan-Harshman, Ph.D., R.D.**  
**FEAST Enterprises, Ontario, Canada**

### Introduction

Recent scientific evidence suggests that diet in general and specific dietary component(s) are important modifiable factors in reducing the risk of chronic diseases, such as osteoporosis, some cancers and cardiovascular diseases (CVD).

The Canadian public are always advised, and rightfully so, to follow Canada's Food Guide to Healthy Eating. However, a large proportion of the general population is not following such dietary recommendations or guidelines. Canadian surveys<sup>1,2</sup> indicate that most people eat less than five servings of fruits and vegetables daily, and only about one-third of Canadians reported eating fruits and vegetables five to ten times per day.

Optimizing the diet of Canadians will have a major impact in reducing the risk of chronic diseases. There is not necessarily a different diet for different diseases, but patterns of eating that include whole grains, plant oils (olive, canola, corn and sunflower) and generous consumption of fruit and vegetables are important. Furthermore, some dietary inadequacies can be corrected with vitamins and minerals, such as calcium, folic acid, vitamin E and selenium among others. There is compelling evidence that complementing the diet with several micronutrients will optimize dietary intake for most people. It is not surprising that many notable scientists are advocating the use of a multivitamin for most of the population<sup>3,4</sup>. This approach is expected to have a health economic savings effect by reducing the cost burden associated with several chronic diseases. Improving the quality of life of most individuals is an additional benefit. This report is an overview of how optimum nutrition can reduce the risk of selected chronic conditions with special emphasis on health economic savings.

### Calcium

The role of optimum intake of calcium for bone health and for reducing the risk of osteoporosis is well established. Five percent of all falls among the elderly result in a fracture, with the hip being the third most frequently fractured bone<sup>5</sup>. In Canada, for example, there are about 24,000 hip fractures annually. The cost of hip fractures in Canada, which includes hospital care, long term care and re-hospitalization, is estimated at about \$650 million<sup>6</sup>. If half the number of fractures could be prevented, among those 65 years and older, by consuming adequate calcium intake through dietary and/or calcium supplements, the Canadian health care system would save about \$300 million each year. In Canada, a representative range of over-the-counter calcium products providing 1,200 mg of elemental calcium daily cost between 20 and 50 cents daily.

Furthermore, there is recent and strong evidence that adequate calcium intake is beneficial for weight control. The economic burden of obesity

was estimated to be over \$1.8 billion, or 2.4% of the total health care expenditures for all diseases in Canada in 1997. The three largest contributors to the cost of obesity were hypertension, type II diabetes and coronary artery disease (or CAD)<sup>7</sup>. Low calcium diets may accelerate weight gain and fat accumulation, whereas high calcium diets may prevent fat gain. During a weight loss regimen, calcium intake may increase thermogenesis and accelerate fat breakdown<sup>8,9</sup>.

### Folic acid

The benefit of periconceptional use of folic acid in reducing the risk of neural tube defects (NTDs) is well established<sup>10</sup>. Also, it appears other birth defects could be reduced with adequate folic acid intake<sup>11-13</sup>. It is generally estimated that 50-70% of NTDs could be prevented through adequate folic acid intake prior to conception and during pregnancy.

Hyperhomocysteinemia has been identified as a new risk factor that may account for up to 10% of CAD<sup>14</sup>. Hyperhomocysteinemia is reduced to normal levels with adequate intakes of folic acid in particular, and sometimes with amounts which are not normally achieved by dietary means for some individuals<sup>15</sup>.

In Canada, flour and pasta have recently been fortified with folic acid for the prevention of neural tube defects. Fortification is estimated to increase the dietary consumption of folic acid by an extra 100 µg, and this increase is expected to contribute to the prevention of heart disease as well<sup>16</sup>. In addition, almost all multivitamin and mineral supplements contain between 400 µg and 700 µg of folic acid. Also, a 1 mg folic acid tablet is readily available in Canada at a cost of about six cents per day or about \$22 per year.

One in twenty Canadians reported having heart disease in 1994-5, and more than 70,000 die each year<sup>17</sup>. Chan et al.<sup>18</sup> calculated that the total cost of CVD in Canada was approximately \$14 to \$20 billion in 1994. Using data from Statistics Canada<sup>19</sup>, food fortification and folate supplementation could prevent up to 5,700 deaths due to CAD yearly, and the total costs of CVD in Canada could be reduced by more than 1 billion dollars.

Long-term supplementation with folic acid may also be useful in protecting against cancer. Giovannucci and colleagues analyzed total, supplementary, and dietary intake of folate in relation to colon cancer risk in the Nurses' Health Study<sup>20</sup>. After 15 years of multivitamin (containing folic acid) use, the risk for colon cancer was significantly lower among women (RR = 0.25; 95% CI = 0.13 - 0.51). Folic acid was recently reported to be beneficial in reducing the risk of breast cancer. This was particular among women who consumed a moderate amount of

alcohol, which is a behavior associated with a higher risk for breast cancer<sup>21</sup>. There is also growing evidence that higher intake of folic acid is associated with lowering the risk of dementia and Alzheimer's disease<sup>22,23</sup>.

### Vitamin E

The average intake of vitamin E from dietary sources is less than 15 IU per day for men and less than 10 IU per day for women. These levels are modest compared to the protective levels of intake (100 IU-200 IU), which were associated with a reduction in the risk of CVD<sup>24,25</sup>.

Vitamin E may prevent atherosclerosis via its antioxidant effects and its inhibitory effects upon smooth muscle proliferation and platelet adhesion. However, a review of recent clinical trials did not demonstrate that vitamin E supplementation had a protective effect against coronary heart disease (CHD) among individuals with a history of heart disease or at an increased risk of heart disease<sup>26</sup>. This is inconsistent with the findings from a number of large cohort studies in men and women and some clinical trials<sup>24,25,27</sup>. In two large cohort studies, vitamin E supplementation of at least 100 IU per day for two or more years was shown to reduce heart disease related outcomes by 37% in men and 41% in women<sup>24,25</sup>. In the CHAOS clinical trial<sup>27</sup>, treatment with alpha-tocopherol of 400 to 800 IU/day significantly reduced the risk of cardiovascular death and non-fatal myocardial infarction (MI).

Multivitamins generally contain about 30 IU of vitamin E, although some multivitamins contain up to 200 IU. Single vitamin E supplements range from 200 to 1,000 IU per capsule. In Canada, a single 400 IU natural vitamin E supplement costs about 10 cents per capsule, but synthetic vitamin E is considerably cheaper.

If the conclusion drawn by Bendich that approximately \$5 billion of annual U.S. hospital charges could have been avoided, if the 65.5 million Americans over age 50 in 1992 had taken at least 100 IU of supplemental vitamin E daily<sup>28</sup>, then in Canada, substantial health care savings would also be expected from vitamin E supplementation.

A recent clinical trial from Finland demonstrated that 50 IU of vitamin E was associated with significant reduction in the incidence as well as the mortality from prostate cancer<sup>29</sup>. Also, vitamin E supplementation was associated with better immune responses and hence expectedly less infections among seniors<sup>30</sup>.

### Selenium

In 1996, a landmark study<sup>31</sup> was published demonstrating that supplementation with 200 µg of selenium reduced cancer risk, particularly prostate, colorectal and lung cancer.

Other research<sup>32</sup> supported the hypothesis that supplemental selenium may reduce the risk of prostate cancer.

Most multivitamin and mineral formulations contain about 25 µg selenium and single supplements ranging from 50 µg to 200 µg are also available.

### Other Nutrients

Vitamin B12 therapy improved some types of metabolic or neurologic abnormalities, and significantly low plasma thiamine has been detected in patients with senile dementia of the Alzheimer type (SDAT), compared to patients without SDAT<sup>33,34</sup>. In the Nun Study, autopsy results showed that low serum folate levels were strongly associated with atrophy of the cerebral cortex<sup>23</sup>.

Cognitive function was poorest in people aged 65 or over who had the lowest vitamin C status. And cognitive impairment was associated with increased mortality, particularly from ischemic stroke. Therefore, high vitamin C intakes might protect against both cognitive impairment and cerebrovascular disease<sup>35,36</sup>. In a recent report from the Nurses' Health Study, women users of vitamin C supplements had a 28% reduction in risk of CHD, whereas in women obtaining vitamin C from dietary sources alone, there was no relationship between vitamin C and CHD<sup>37</sup>.

Micronutrients such as vitamin C, zinc and vitamin E are being studied to determine their impact on eye diseases. Vitamin C may also decrease the incidence of cataracts among older individuals. The intake of vitamin C supplements for 10 or more years was associated with a substantial reduction in risk of cataracts<sup>38</sup>. Also, the protective effect of phytochemicals against macular degeneration is being studied. Lutein is one such substance.

### Conclusion

There is little doubt that optimum nutrition is associated with lowering the risk of several diseases and improving the quality of life of

Canadians. One should always strive to follow Canada's Food Guide for Healthy Eating, however, many medical and nutritional authorities are arguing that it might be prudent to complement the diet with a daily multivitamin as a nutritional insurance. A multivitamin supplement costs about 11 cents per day in Canada, and a year's supply of a national brand of a multivitamin and mineral supplement would cost less than \$45.

Some individuals might also consider taking single supplements of micronutrients such as calcium, vitamins C and E, or selenium. When supplementation is combined with increased physical activity, abstaining from smoking, maintaining a normal body weight, and eating a healthy diet, this would translate into several millions of dollars in savings for the health care system, but most importantly, Canadians can expect to enjoy better quality of life and health.

Table 1. Vitamins, minerals and their potential health benefits.

Micronutrients	Disease or Condition
Calcium	Osteoporosis Weight control
Folic acid	Neural tube defects Heart disease Cancer (colon, breast) Cognitive function
Vitamin E	Heart disease Cancer (prostate) Immunity Eye disease
Selenium	Cancer (prostate, colorectal, lung)
Vitamin B12	Cognitive function Heart disease
Vitamin C	Cognitive function Heart disease Eye disease

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- References** 1. Perez CE. Fruit and vegetable consumption. *Health Reports* 13(3) 2002; Statistics Canada 82-003. 2. Canadian Community Health Survey 2000/2001. Statistics Canada, Ottawa. 3. Fletcher RH, Fairfield KM. Vitamins for chronic disease prevention in adults: Clinical applications. *J Am Med Assoc* 2002; 287:3127-9. 4. Willett WC, Stampfer MJ. What vitamins should I be taking, doctor? *N Engl J Med* 2001; 345:1819-24. 5. Tinetti ME, Speechly M. Prevention of falls among the elderly. *New Engl J Med* 1989; 320:1055-9. 6. Wiktorowicz ME, Goeree R, Papaioannou A, Adachi JD, Papadimitropoulos E. Economic implications of hip fracture: Health service use, institutional care and cost in Canada. *Osteoporos Int* 2001; 12:271-8. 7. Birmingham CL, Muller JL, Palepu A, Spinelli JJ, Anis AH. The cost of obesity in Canada. *Can Med Assoc J* 1999; 160(4):483-8. 8. Zemel MB. Role of dietary calcium and dairy products in modulating adiposity. *Lipids* 2003; 38:130-46. 9. Teegarden D. Calcium intake and reduction in weight or fat mass. *J Nutr* 2003; 133:249S-251S. 10. MRC Vitamin Study Research Group. Prevention of neural tube defects: Results of the Medical Research Council Vitamin Study. *Lancet* 1991; 338:131-7. 11. Czeizel AE. Reduction of urinary tract and cardiovascular defects by periconceptional multivitamin supplementation. *Am J Med Genetics* 1996; 62:179-83. 12. Botto LD, Khoury MJ, Mulinare J, Erickson JD. Periconceptional multivitamin use and the occurrence of conotruncal heart defects: Results from a population-based, case-control study. *Pediatrics* 1996; 98:911-7. 13. Botto LD, Mulinare J, Erickson JD. Occurrence of congenital heart defects in relation to maternal multivitamin use. *Am J Epidemiol* 2000; 151:878-84. 14. Boushey CJ, Beresford SAA, Omenn GS, Motulsky AG. A quantitative assessment of plasma homocysteine as a risk factor for vascular disease: Probable benefits of increasing folic acid intakes. *J Am Med Assoc* 1995; 274:1049-57. 15. Omenn GS, Beresford SAA, Motulsky AG. Preventing coronary heart disease: B vitamins and homocysteine. *Circulation* 1998; 97:421-4. 16. Tice JA, Ross E, Coxson PG, Rosenberg I, Weinstein MC, Hunink MGM, et al. Cost-effectiveness of vitamin therapy to lower plasma homocysteine levels for the prevention of coronary heart disease: Effect of grain fortification and beyond. *J Am Med Assoc* 2001; 286:936-43. 17. Johansen H, Nair C, Taylor G. Current and future hospitalization after heart attack. *Health Reports*, 10(2) 1998; Statistics Canada, Catalogue 82-003. 18. Chan B, Coyte P, Heick D. Economic impact of cardiovascular disease in Canada. *Can J Cardiol* 1996; 12:1000-6. 19. Statistics Canada. Canadian statistics. Retrieved March 2003. Available from URL: <http://www.statcan.ca>. 20. Giovannucci E, Stampfer MJ, Colditz GA, Hunter DJ, Fuchs C, Rosner BA, et al. Multivitamin use, folate, and colon cancer in women in the Nurses' Health Study. *Ann Intern Med* 1998; 129:517-24. 21. Zhang S, Hunter DJ, Hankinson SE, Giovannucci EL, Rosner BA, Colditz GA, et al. A prospective study of folate intake and the risk of breast cancer. *J Am Med Assoc* 1999; 281:1632-7. 22. Miller JW. Homocysteine and Alzheimer's disease. *Nutr Rev* 1999; 57:126-129. 23. Snowdon DA, Tully CL, Smith CD, Perez Riley K, Markesbery WR. Serum folate and the severity of atrophy of the neocortex in Alzheimer disease: Findings from the Nun Study. *Am J Clin Nutr* 2000; 71:993-998. 24. Rimm EB, Stampfer MJ, Ascherio A, Giovannucci E, Colditz GA, Willett WC. Vitamin E consumption and the risk of coronary heart disease in men. *N Engl J Med* 1993; 328:1450-6. 25. Stampfer MJ, Hennekens CH, Manson JE, Colditz GA, Rosner B, Willett WC. Vitamin E consumption and the risk of coronary heart disease in women. *N Engl J Med* 1993; 328:1444-9. 26. Fairfield KM, Fletcher RH. Vitamins for chronic disease prevention in adults: Scientific review. *J Am Med Assoc* 2002; 287:3116-26. 27. Stephens NG, Parsons A, Schofield PM, Kelly F, Cheeseman K, Mitchinson MJ. Randomized controlled trial of vitamin E in patients with coronary disease: Cambridge Heart Antioxidant Study (CHAOS). *Lancet* 1996; 347:781-6. 28. Bendich A, Mallick R, Leader S. Potential health economic benefits of vitamin supplementation. *West J Med* 1997; 166:306-12. 29. Heinonen OP, Albanes D, Virtamo J, Taylor PR, Huttunen JK, Hartman AM, et al. Prostate cancer and supplementation with alpha-tocopherol and beta-carotene: Incidence and mortality in a controlled trial. *J Natl Cancer Inst* 1998; 90:440-6. 30. Meydani SN, Meydani M, Blumberg JB, Leka LS, Siber G, Loszewski R, et al. Vitamin E supplementation and in vivo immune response in healthy elderly subjects. A randomized controlled trial. *J Am Med Assoc* 1997; 277:1380-6. 31. Clark LC, Combs GF Jr, Turnbull BW, et al. Effects of selenium supplementation for cancer prevention in patients with carcinoma of the skin: A randomized controlled trial. Nutritional Prevention of Cancer Study Group. *J Am Med Assoc* 1996; 276:1957-1963. 32. Brooks JD, Metter J, Chan DW, Sokoll LJ, Landis P, Nelson WG, et al. Plasma selenium level before diagnosis and the risk of prostate cancer development. *J Urol* 2001; 166:2034-8. 33. Carmel R, Gott PS, Waters CH, Cairo K, Green R, Bondareff W, et al. The frequently low cobalamin levels in dementia usually signify treatable metabolic, neurologic and electrophysiologic abnormalities. *Eur J Haematol* 1995; 54:245-253. 34. Gold M, Chen MF, Johnson K. Plasma and red blood cell thiamine deficiency in patients with dementia of the Alzheimer's type. *Arch Neurol* 1995; 52:1081-1086. 35. Gale CR, Martyn CN, Cooper C. Cognitive impairment and mortality in a cohort of elderly people. *Br Med J* 1996; 312:608-611. 36. Jama JW, Launer LJ, Witteman JC, den Breeijen JH, Breteler MM, Grobbee DE, et al. Dietary antioxidants and cognitive function in a population-based sample of older persons. The Rotterdam Study. *Am J Epidemiol* 1996; 144:275-280. 37. Osganian SK, Stampfer MJ, Rimm E, Spiegelman D, Hu FB, Manson JE, et al. Vitamin C and risk of coronary heart disease in women. *J Am Coll Cardiol* 2003; 42:246-52. 38. Simon JA, Hudes ES. Serum ascorbic acid and other correlates of self-reported cataract among older Americans. *J Clin Epidemiol* 1999; 52:1207-1211.