Consumption of vitamin C is below recommended daily intake in many cancer patients and healthy volunteers in Christchurch

Vitamin C (ascorbate) is an essential micronutrient required for numerous biological functions, including its action as a cofactor for enzymes. As cofactor, it is required for the synthesis of collagen, carnitine, neurotransmitters, and peptide hormones, and in the regulation of specific epigenetic enzymes and transcription factors. Most animals can synthesise ascorbate from glucose, but humans cannot due to mutations in the biosynthesis pathway. Because ascorbate is highly water-soluble and has a high turnover rate, a regular and adequate dietary intake is essential to prevent hypovitaminosis C and the deficiency disease scurvy. Low levels of ascorbate are common, especially in at-risk groups such as those on low income, smokers or severely ill patients.

Anecdotal evidence suggests that cancer patients often modify their dietary habits to improve nutrition and vitamin intake. We aimed to determine whether this is the case with respect to intake of ascorbate by cancer patients, compared with healthy volunteers, and to relate this to national guidelines.

Participants were recruited to report dietary habits via a written survey. All suitable adult cancer patients attending Oncology Services at Christchurch hospital, for appointments or therapy during the survey period (1 November–31 December 2012) were approached and invited to participate. Healthy volunteers were recruited via a variety of community-based approaches to match cancer patients by age and gender.

A single time-point survey of dietary habits was conducted. It included questions on food frequency (how much and how often fruit, vegetables, fruit or vegetable drinks and vitamin supplements were consumed) and whether (and why) their intake had changed recently, a 24h diet recall (what and how much food and drink was consumed in the previous 24 hours), and a 1-week food diary (details of food types and quantities over a one week period). Ascorbate intake was calculated from the reported food and drink consumption, as well as supplement intake, using the FoodWorks Nutrition Software for diet and recipe analysis (FoodWorks© 2007).

For this survey, 104 participants were recruited (50 cancer patients and 54 healthy controls). Half in each group were female, the mean age (57 years), ethnicity and BMI were similar, and smoking status was comparable, although fewer cancer patients were current smokers. Most cancer patients had breast cancer, then colorectal cancer, followed by other types of cancers. Half of all cancer patients were undergoing chemotherapy, and 30% had advanced disease.

More than half of the cancer patients (30/50) reported a change in diet following diagnosis, with none of the healthy volunteers reporting a recent change. Yet, both groups reported similar ascorbate consumption, with mean daily ascorbate intake...
calculated from all three questionnaires of 196 mg for cancer patients and 185 mg for healthy volunteers.

Ten of the cancer patients, and 9 of the healthy controls, reported using supplements containing ascorbate, ranging from 6–1026 mg per day (mean 63 mg/day) for cancer patients, and 4–1075 mg per day (mean 66 mg/day) for healthy controls. Of the 50 cancer patients, 3 mentioned being told by clinicians to avoid ascorbate supplementation, with a total of 7 cancer patients reporting reduced supplement use and 2 reporting increased supplement use since diagnosis.

For further analysis, participants were placed into three categories: below recommended daily intake (RDI, less than 45 mg per day), above RDI but below suggested dietary target (SDT) to prevent chronic diseases (45–200 mg per day), and at and above SDT (above 200 mg per day).  

According to the 24h recall data (including supplements), 23% of cancer patients and 20% of healthy controls consumed ascorbate below RDI. Most participants had between the RDI and SDT intake (57% and 50% for cancer and controls, respectively), whereas 20% of cancer patients and 30% of controls had intakes at and above the SDT. The other two dietary questionnaires showed similar trends.

Overall, 80% of cancer patients, and 70% of healthy controls consumed less ascorbate than that recommended by the New Zealand Ministry of Health (MOH)\(^7\) to prevent chronic diseases.

The impact of current chemotherapy treatment on diet was explored in the cancer patient cohort to determine whether treatment changed dietary habits. Although generally intake was similar regardless of treatment, ascorbate intake derived from drinks was higher in patients undergoing chemotherapy (94 mg) compared to other cancer patients (20 mg; p=0.04).

Overall, cancer patients are aware of the need for a healthy diet, yet 80% consumed less ascorbate than the amount recommended by the MOH.\(^7\) Our pilot data may be clinically important, as suboptimal ascorbate intake in the general population is associated with all-cause mortality,\(^4\) plasma ascorbate concentrations decrease with increasing age,\(^8\) and estimated intake is predictive of cancer risk.\(^9\)

Further research to measure ascorbate levels in samples from cancer patients\(^10\) will provide more definitive information and help gauge the level of intervention required to restore healthy levels. Meanwhile, we support health messages which educate the public of the importance of eating a healthy diet.

Although five servings per day of fruit and vegetables can provide 200 mg/d of vitamin C (SDT), this will only be the case if one of these servings is a high vitamin C food, such as citrus or kiwifruit, as many commonly consumed foods, such as apples and bananas, contain relatively low levels of vitamin C.

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