Associate Professor Anitra Carr

Director, Nutrition in Medicine Research Group
Principal Investigator

BSc(Hons)(Cant), PhD(Otago)

Email anitra.carr@otago.ac.nz
Tel +64 3 364 0649

Research interests

Associate Professor Anitra Carr's research speciality is the role of vitamin C in human health and disease. Associate Professor Carr has a background in biochemistry and biomedical research and now carries out translational 'bench-to-bedside' studies. She is currently running both observational and interventional studies investigating the bioavailability and health effects of vitamin C. She is particularly interested in the role of vitamin C in the prevention and treatment of acute and chronic diseases such as cancer and severe infection.

Associate Professor Carr obtained a PhD from the Department of Pathology, University of Otago, Christchurch, followed by an American Heart Association Post-doctoral Fellowship which was carried out at the Linus Pauling Institute, Oregon State University, USA. Whilst there she produced a number of high impact publications on the role of vitamin C in human health and disease; two of these supported the most recent increase of the US recommended dietary intakes for vitamin C by the US Food and Nutrition Board of the Institutes of Medicine.

Associate Professor Carr returned to the University of Otago, Christchurch, and was awarded a Sir Charles Hercus Health Research Fellowship from the Health Research Council of New Zealand to undertake research into the role of vitamin C in severe infection, particularly pneumonia and sepsis. She has also investigated the effects of intravenous vitamin C on cancer and chemotherapy-related symptoms and quality of life. Associate Professor Carr hopes to not only elucidate the underlying mechanisms of action of vitamin C, but to also improve the outcomes of patients with these conditions.

Research expertise

Vitamin C bioavailability and health effects; recommended dietary intakes; fatigue and quality of life; cancer; severe infection; clinical studies.

In the media

- Watch or listen to Associate Professor Anitra Carr's public lectures and interviews.

Major review articles

- Carr AC and Cook J. Intravenous vitamin C for cancer therapy – identifying the current gaps in our knowledge. Frontiers in Physiology - Clinical and Translational Physiology. 2018. 9 (article 1182), 1-16. doi: 10.3389/fphys.2018.01182.
- Carr AC and Maggini S. Vitamin C and immune function. Nutrients. 2017. 9 (11). pii: E1211. doi: 10.3390/nu9111211.
- Carr AC, McCall C. The role of vitamin C in the treatment of pain: new insights. J Transl Med. 2017 Apr 14;15(1):77.
- Carr A.C., Shaw, G.M., Fowler, A.A., Natarajan, R. Ascorbate-dependent vasopressor synthesis: a rationale for vitamin C administration in severe sepsis and septic shock? Critical Care. 2015. 19, 418.
- Carr, AC, Vissers MC, Cook, JS. The effect of intravenous vitamin C on cancer- and chemotherapy-related fatigue and quality of life. Frontiers Oncology, 2014. 4 (283), 1-7.
- Carr, AC, Vissers, MCM. Synthetic or food-derived vitamin C – are they equally bioavailable? Nutrients. 2013. 5, 4284-4304.
- Carr, A.C., Zhu, B-Z, and Frei, B. Potential anti-atherogenic mechanisms of ascorbate (vitamin C) and alpha-tocopherol (vitamin E). Circ Res. 2000. 87, 349-354.
- Carr, A.C., Frei, B. The role of natural antioxidants in preserving the biological activity of endothelium-derived nitric oxide. Free Radic Biol Med. 2000. 28, 1806-1814.
- Carr, A.C., McCall, M.R., Frei, B. Oxidation of LDL by myeloperoxidase and reactive nitrogen species: reaction pathways and antioxidant protection. Arterio Thromb Vasc Biol. 2000. 20, 1716-1723.
- Carr, A.C.,Frei, B. Toward a new recommended dietary allowance for vitamin C based on antioxidant and health effects in humans. Am J Clin Nutr. 1999. 69, 1086-1107.
- Carr, A.C., Frei, B. Does vitamin C act as a pro-oxidant under physiological conditions? FASEB J. 1999. 13, 1007-1024.

Publications

Chapter in Book - Research

Carr, A., & Cheng, C. P. (2019). Veins of the upper body. In C. P. Cheng (Ed.), *Handbook of vascular motion*. (pp. 225-246). London, UK: Academic Press. doi: 10.1016/B978-0-12-815713-8.00011-5

Vissers, M. C. M., Carr, A. C., Pullar, J. M., & Bozonet, S. M. (2013). The bioavailability of vitamin C from kiwifruit. In M. Boland & P. J. Moughan (Eds.), *Nutritional benefits of kiwifruit*. (pp. 125-147). Waltham, MA: Academic Press. doi: 10.1016/b978-0-12-394294-4.00007-9

Journal - Research Article

Pullar, J. M., Dunham, S., Dachs, G. U., Vissers, M. C. M., & Carr, A. C. (2020). Erythrocyte ascorbate is a potential indicator of steady-state plasma ascorbate concentrations in healthy non-fasting individuals. *Nutrients*, *12*(2), 418. doi: 10.3390/nu12020418

Bozonet, S. M., & Carr, A. C. (2019). The role of physiological vitamin C concentrations on key functions of neutrophils isolated from healthy individuals. *Nutrients*, *11*(6), 1363. doi: 10.3390/nu11061363

Carr, A. C., Spencer, E., Hoskin, T. S., Rosengrave, P., Kettle, A. J., & Shaw, G. (2019). Circulating myeloperoxidase is elevated in septic shock and is associated with systemic organ failure and mortality in critically ill patients. *Free Radical Biology & Medicine*. Advance online publication. doi: 10.1016/j.freeradbiomed.2019.11.004

Zawari, M., Poller, B., Walker, G., Pearson, A., & Carr, A. C. (2019). Formulation of broccoli sprout powder in gastro-resistant capsules protects against the acidic pH of the stomach in vitro but does not increase isothiocyanate bioavailability in vivo. *Antioxidants*, *8*(9), 359. doi: 10.3390/antiox8090359

Prier, M., Carr, A. C., & Baillie, N. (2018). No reported renal stones with intravenous vitamin C administration: A prospective case series study. *Antioxidants*, *7*(5), 68. doi: 10.3390/antiox7050068

Carr, A. C., & Cook, J. (2018). Intravenous vitamin C for cancer therapy: Identifying the current gaps in our knowledge. *Frontiers in Physiology*, *9*, 1182. doi: 10.3389/fphys.2018.01182

Wilson, R., Willis, J., Gearry, R. B., Hughes, A., Lawley, B., Skidmore, P., Frampton, C., Fleming, E., Anderson, A., Jones, L., Tannock, G. W., & Carr, A. C. (2018). SunGold kiwifruit supplementation of individuals with prediabetes alters gut microbiota and improves Vitamin C status, anthropometric and clinical markers. *Nutrients*, *10*, 895. doi: 10.3390/nu10070895

Pullar, J. M., Carr, A. C., Bozonet, S. M., & Vissers, M. C. M. (2018). High vitamin C status is associated with elevated mood in male tertiary students. *Antioxidants*, *7*(7), 91. doi: 10.3390/antiox7070091

Pullar, J. M., Bayer, S., & Carr, A. C. (2018). Appropriate handling, processing and analysis of blood samples is essential to avoid oxidation of vitamin C to dehydroascorbic acid. *Antioxidants*, *7*(2), 29. doi: 10.3390/antiox7020029

Wilson, R., Willis, J., Gearry, R., Skidmore, P., Fleming, E., Frampton, C., & Carr, A. (2017). Inadequate vitamin C status in prediabetes and type 2 diabetes mellitus: Associations with glycaemic control, obesity, and smoking. *Nutrients*, *9*(9), 997. doi: 10.3390/nu9090997

Brookie, K. L., Mainvil, L. A., Carr, A. C., Vissers, M. C. M., & Conner, T. S. (2017). The development and effectiveness of an ecological momentary intervention to increase daily fruit and vegetable consumption in low-consuming young adults. *Appetite*, *108*, 32-41. doi: 10.1016/j.appet.2016.09.015

Conner, T. S., Brookie, K. L., Carr, A. C., Mainvil, L. A., & Vissers, M. C. M. (2017). Let them eat fruit! The effect of fruit and vegetable consumption on psychological well-being in young adults: A randomized controlled trial. *PLoS ONE*, *12*(2), e0171206. doi: 10.1371/journal.pone.0171206

Carr, A. C., & Maggini, S. (2017). Vitamin C and Immune Function. *Nutrients*, *9*(11), 1211. doi: 10.3390/nu9111211

Pullar, J. M., Carr, A. C., & Vissers, M. C. M. (2017). The roles of vitamin C in skin health. *Nutrients*, *9*(8), 866. doi: 10.3390/nu9080866

Pullar, J. M., Carr, A. C., Bozonet, S. M., Rosengrave, P., Kettle, A. J., & Vissers, M. C. M. (2017). Elevated seminal plasma myeloperoxidase is associated with a decreased sperm concentration in young men. *Andrology*, *5*(3), 431-438. doi: 10.1111/andr.12327

Pearson, J. F., Pullar, J. M., Wilson, R., Spittlehouse, J. K., Vissers, M. C. M., Skidmore, P. M. L., Willis, J., Cameron, V. A., & Carr, A. C. (2017). Vitamin C status correlates with markers of metabolic and cognitive health in 50-year-olds: Findings of the CHALICE Cohort Study. *Nutrients*, *9*(8), 831. doi: 10.3390/nu9080831

Carr, A. C., Rosengrave, P. C., Bayer, S., Chambers, S., Mehrtens, J., & Shaw, G. M. (2017). Hypovitaminosis C and vitamin C deficiency in critically ill patients despite recommended enteral and parenteral intakes. *Critical Care*, *21*, 300. doi: 10.1186/s13054-017-1891-y

Carr, A. C., Pullar, J. M., Bozonet, S. M., & Vissers, M. C. M. (2016). Marginal ascorbate status (Hypovitaminosis C) results in an attenuated response to vitamin C supplementation. *Nutrients*, *8*(6), 341. doi: 10.3390/nu8060341

Carr, A. C., Shaw, G. M., Fowler, A. A., & Natarajan, R. (2015). Ascorbate-dependent vasopressor synthesis: A rationale for vitamin C administration in severe sepsis and septic shock? *Critical Care*, *19*, 418. doi: 10.1186/s13054-015-1131-2

Bozonet, S. M., Carr, A. C., Pullar, J. M., & Vissers, M. C. M. (2015). Enhanced human neutrophil vitamin C status, chemotaxis and oxidant generation following dietary supplementation with vitamin C-rich *SunGold* kiwifruit. *Nutrients*, *7*(4), 2574-2588. doi: 10.3390/nu7042574

Carr, A. C., Vissers, M. C. M., & Cook, J. S. (2014). The effect of intravenous vitamin C on cancer- and chemotherapy-related fatigue and quality of life. *Frontiers in Oncology*, *4*, 283. doi: 10.3389/fonc.2014.00283

Carr, A. C., Bozonet, S. M., Pullar, J. M., & Vissers, M. C. M. (2013). Mood improvement in young adult males following supplementation with gold kiwifruit, a high-vitamin C food. *Journal of Nutritional Science*, *2*, e24. doi: 10.1017/jns.2013.12

Carr, A. C., Bozonet, S. M., Pullar, J. M., Simcock, J. W., & Vissers, M. C. M. (2013). A randomized steady-state bioavailability study of synthetic versus natural (kiwifruit-derived) vitamin C. *Nutrients*, *5*(9), 3684-3695. doi: 10.3390/nu5093684

Carr, A. C., & Vissers, M. C. M. (2013). Synthetic or food-derived vitamin C—are they equally bioavailable? *Nutrients*, *5*(11), 4284-4304. doi: 10.3390/nu5114284

Carr, A. C., Bozonet, S. M., Pullar, J. M., Simcock, J. W., & Vissers, M. C. M. (2013). Human skeletal muscle ascorbate is highly responsive to changes in vitamin C intake and plasma concentrations. *American Journal of Clinical Nutrition*, *97*, 800-807. doi: 10.3945/ajcn.112.053207

Carr, A. C., Bozonet, S. M., & Vissers, M. C. M. (2013). A randomised cross-over pharmacokinetic bioavailability study of synthetic *versus* kiwifruit-derived vitamin C. *Nutrients*, *5*(11), 4451-4461. doi: 10.3390/nu5114451

Carr, A. C., Pullar, J. M., Moran, S., & Vissers, M. C. M. (2012). Bioavailability of vitamin C from kiwifruit in non-smoking males: Determination of 'healthy' and 'optimal' intakes. *Journal of Nutritional Science*, *1*, e14. doi: 10.1017/jns.2012.15

Vissers, M. C. M., Carr, A. C., & Winterbourn, C. C. (2001). Fatty acid chlorohydrins and bromohydrins are cytotoxic to human endothelial cells. *Redox Report*, *6*, 49-55. doi: 10.1179/135100001101536030

Carr, A., van den Berg, J. J. M., & Winterbourn, C. C. (1998). Differential reactivities of hypochlorous and hypobromous acids with purified E.coli phospholipid: formation of haloamines and halohydrins. *Biochimica et Biophysica Acta: General Subjects*, *1392*, 254-264.

Vissers, M. C. M., Carr, A. C., & Chapman, A. L. P. (1998). A comparison of human red cell lysis by hypochlorous and hypobromous acid: insights into the mechanism of lysis. *Biochemical Journal*, *330*, 131-138. doi: 10.1042/bj3300131

Carr, A., Winterbourn, C. C., Blunt, J. W. W., Phillips, A., & Abell, A. D. (1997). Nuclear magnetic resonance characterization of 6a-chloro-5b-cholestane-3b, 5-diol formed from the reaction of hypochlorous acid with cholesterol. *Lipids*, *32*(4), 363-367.

Domigan, N. M., Carr, A. C., Lewis, J. G., Elder, P. A., & Winterbourn, C. C. (1997). A monoclonal antibody recognizing the chlorohydrin derivatives of oleic acid for probing hypochlorous acid involvement in tissue injury. *Redox Report*, *3*(2), 111-117.

Carr, A., & Winterbourn, C. C. (1997). Oxidation of neutrophil glutathione and protein thiols by myeloperoxidase-derived hypochlorous acid. *Biochemical Journal*, *327*(1), 275-281.

Carr, A. C., Vissers, M. C., Domigan, N. M., & Winterbourn, C. C. (1997). Modification of red cell membrane lipids by hypochlorus acid and haemolysis by preformed lipid chlorohydrins. *Redox Report*, *3*, 263-271.

Carr, A., Winterbourn, C. C., & van den Berg, J. J. M. (1996). Peroxidase-mediated bromination of unsaturated fatty acids to form bromohydrins. *Archives of Biochemistry & Biophysics*, *327*, 227-233.

Carr, A., van den Berg, J. J. M., & Winterbourn, C. C. (1996). Chlorination of cholesterol in cell membranes by hypochlorous acid. *Archives of Biochemistry & Biophysics*, *332*, 63-69.

Inder, T. E., Carr, A. C., Winterbourn, C. C., Austin, N. C., & Darlow, B. A. (1995). Vitamin A and E status in very low birth weight infants: Development of an improved parenteral delivery system. *Journal of Pediatrics*, *126*(1), 128-131. doi: 10.1016/S0022-3476(95)70515-5

Thomas, C., Carr, A. C., & Winterbourn, C. C. (1994). Free radical inactivation of rabbit muscle creatinine kinase: Catalysis by physiological and hydrolized ICRF-187 (ICRF-198) iron chelates. *Free Radical Research*, *21*(6), 387-397.

Kettle, A. J., Carr, A. C., & Winterbourn, C. C. (1994). Assays using horseradish peroxidase and phenolic substrates require superoxide dismutase for accurate determination of hydrogen peroxide production by neutrophils. *Free Radical Biology & Medicine*, *17*(2), 161-164.

Winterbourn, C. C., & Carr, A. C. (1993). Myeloperoxidase-dependent loss of malondialdehyde: A limitation for detecting neutrophil-mediated lipid peroxidation. *Archives of Biochemistry & Biophysics*, *302*(2), 461-467. doi: 10.1006/abbi.1993.1240

Journal - Research Other

Masse, M.-H., Menard, J., Sprague, S., Battista, M.-C., Cook, D. J., Guyatt, G. H., ... Carr, A., ... and on behalf of the Canadian Critical Care Trials Group. (2020). Lessening organ dysfunction with VITamin C (LOVIT): Protocol for a randomized controlled trial. *Trials*, *21*, 42. doi: 10.1186/s13063-019-3834-1

Liugan, M., & Carr, A. C. (2019). Vitamin C and neutrophil function: Findings from randomized controlled trials. *Nutrients*, *11*, 2102. doi: 10.3390/nu11092102

Fujii, T., Belletti, A., Carr, A., Furukawa, T. A., Luethi, N., Putzu, A., ... Bellomo, R. (2019). Vitamin C therapy for patients with sepsis or septic shock: A protocol for a systematic review and a network meta-analysis. *BMJ Open*, *9*(11), e033458. doi: 10.1136/bmjopen-2019-033458

Carr, A. C. (2019). Duration of intravenous vitamin C therapy is a critical consideration. *Critical Care & Resuscitation*, *21*(3), 220-221. [Letter].

Carr, A. C. (2018). Can a simple chemical help to both prevent and treat sepsis. *Critical Care*, *22*, 247. doi: 10.1186/s13054-018-2161-3

Foster, M. N., Carr, A. C., Antony, A., Peng, S., & Fitzpatrick, M. G. (2018). Intravenous vitamin C administration improved blood cell counts and health-related quality of life of patient with history of relapsed acute myeloid leukaemia. *Antioxidants*, *7*(7), 92. doi: 10.3390/antiox7070092

Baillie, N., Carr, A. C., & Peng, S. (2018). The use of intravenous vitamin C as a supportive therapy for a patient with glioblastoma multiforme. *Antioxidants*, *7*(9), 115. doi: 10.3390/antiox7090115

Carr, A. C., & McCall, C. (2017). The role of vitamin C in the treatment of pain: New insights. *Journal of Translational Medicine*, *15*, 77. doi: 10.1186/s12967-017-1179-7

Fewer publications...