Author's response to reviews

Title: Relationships of low serum vitamin D3 with anthropometry and markers of the metabolic syndrome and diabetes in overweight and obesity

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Version: 6 Date: 26 January 2008

Author's response to reviews: see over
Date: 26.01.2008

Covering letter for final manuscript draft to:

The Editor
Nutrition Journal
Dear Sir/Madam
Please find attached the pre-accept edit SHORT REPORT.

Title:
Relationships of low serum vitamin D$_3$ with anthropometry and markers of the metabolic syndrome and diabetes in overweight and obesity.

Formatting changes requested
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Abbreviations: Please write the abbreviations in sentence form instead of as a list. For example: vitamin D$_3$: serum 25 hydroxyvitamin D$_3$; TIIDM: type II Diabetes Mellitus; BMI: body mass index; waist: waist circumference; weight: body weight; fat%: body fat percentage; etc.

This change has been made

Please use sentence case for all headings, such as change Figure Legends to Figure legends (lower case l).

All headings should not be in sentence case

Figure legends: Please reposition the figure legends section after the references.

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Thank you.

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**Emails and Qualifications**


Low serum 25 hydroxyvitamin D₃ (vitamin D₃) is known to perturb cellular function in many tissues, including the endocrine pancreas, which are involved in obesity and type II diabetes mellitus (TIIDM). Vitamin D₃ insufficiency has been linked to obesity, whether obesity is assessed by body mass index (BMI) or waist circumference (waist). Central obesity, using waist as the surrogate, is associated with the metabolic syndrome (MetSyn), insulin resistance, TIIDM and atherosclerotic cardiovascular disease (CVD). We tested how vitamin D₃ was related to measures of fat mass, MetSyn markers, haemoglobin A₁c (HbA₁c) and MetSyn in a cross-sectional sample of 250 overweight and obese adults of different ethnicities. There were modest inverse associations of vitamin D₃ with body weight (weight) (r=-0.21, p=0.0009), BMI (r=-0.18, p=0.005), waist (r=-0.14, p=0.03), [but not body fat % (r=-0.08, p=0.24)], and HbA₁c (r=-0.16, p=0.01). Multivariable regression carried out separately for BMI and waist showed a decrease of
0.74 nmol/L (p=0.002) in vitamin D₃ per 1 kg/m² increase in BMI and a decrease of 0.29 nmol/L (p=0.01) per 1 cm increase in waist, with each explaining approximately 3% of the variation in vitamin D₃ over and above gender, age, ethnicity and season.

The similar relationships of BMI and waist with vitamin D₃ may have been due to associations between BMI and waist or coincidental, where different mechanisms relating hypovitaminosis D₃ to obesity occur concurrently. Previously reviewed mechanisms include that 1) low vitamin D₃, may impair insulin action, glucose metabolism and various other metabolic processes in adipose and lean tissue 2) fat soluble-vitamin D₃ is sequestered in the large adipose compartment, and low in serum, 3) obese people may be sensitive about their body shape, minimising their skin exposure to view and sunlight (not tested). We showed evidence for the first theory but no evidence to support the second. In the current study, serum vitamin D₃ was inversely related to weight, BMI and markers of TIIIDM (large waist, raised HbA₁c) but not to adipose mass nor to MetSyn per se.

Running title:

Low Vitamin D₃ with high BMI, Waist and HbA₁c

Key words:

Vitamin D₃, Hypovitaminosis D₃, BMI, Waist, HbA₁c, Metabolic syndrome,

Competing interests:

The author(s) declare that they have no competing interests.

Authors' contributions:

A-TM conceived the study and was the senior author during manuscript preparation. A-TM, FEL, SDP and CMS contributed to the planning, conduct, and reporting of this
study. JMS, A-TM and CMS did the data entry and statistical analysis. A-TM, FEL, SDP and CMS contributed to manuscript preparation. Funds were raised by A-TM and SDP as part of a wider programme grant.

Authority
I confirm all authors have approved this paper for submission to the Nutrition Journal

Acknowledgements
We thank the Health Research Council of New Zealand for funding the main ECHO trial and Healtheries Ltd, New Zealand for funding the Vitamin D₃ assays, the Clinical Trials Research Unit, University of Auckland, Jane Easton (Study Manager), Santuri Rungan, Chao-Yuan Chen, David Anderson, Laura Gerulitis, Pia Nielson, Jeannette Eis, Cathelijne Reincke, Shannon McCarthy, Jenneke van Drunen (Research Assistants) and the 250 participants.

Yours truly,

Anne-Thea McGill