Lack of relationship between chromium and blood glucose concentration in the chromium deficient and free-living populations

Anna Chu[1], Ramez Alhazzaa[2], Peter Varelis[2], Dorothy Mackerras[2], Samir Samman[1,3]

[1]Department of Human Nutrition, University of Otago [2]Food Standards Australia New Zealand
[3]Discipline of Nutrition and Metabolism, School of Life and Environmental Sciences, University of Sydney

Introduction

Chromium has been associated with the maintenance of blood glucose levels in chromium deficient and healthy populations. No previous systematic review has summarised the effect of chromium on glycaemic control in the chromium deficient population.

Objective

To determine the relationship between chromium and blood glucose concentration in chromium deficient and free-living populations.

Methods

We conducted a systematic literature review of PubMed, EMBASE and Cochrane Central, from inception to the 25th May 2015, to identify RCT or case series/reports for studies of chromium supplementation in chromium deficient population (Figure 1). A qualitative synthesis of the outcomes was completed.

In the free-living population, an update of a previous systematic review (Balk et al. 2007 Diabetes Care) was conducted. MEDLINE and Commonwealth Agricultural Bureau were searched for original research papers published from January 2006 to 17th July 2015, to identify RCT that included chromium supplementation, as per Balk et al.'s inclusion criteria. An update of the meta-analyses of effect in normoglycaemic and impaired glucose tolerance populations, in addition to the GRADE assessment of the evidence, were conducted.

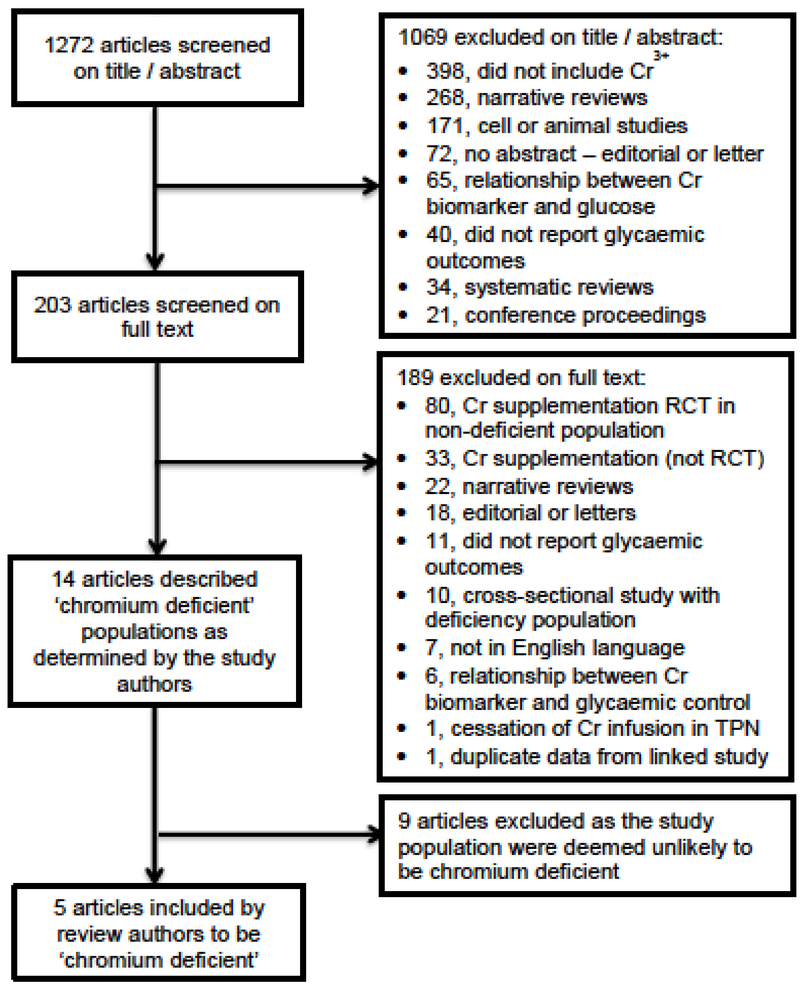

Figure 1. PRISMA diagram showing the systematic review process for the 'chromium deficient' population

Results

Chromium deficient population: Five case reports were included in the chromium deficient population describing the effects of chromium supplementation on glycaemic control in patients on long term total parenteral nutrition (Table 1). All of the included studies were at a high risk of bias due to the existence of numerous confounding factors.

Free-living population: In the present update, three new studies were included; two studies conducted in adults with impaired glucose tolerance (Ali et al. 2011) or metabolic syndrome (Iqbal et al. 2009) and another in normoglycaemic, overweight children (Kim et al. 2011).Meta-analyses of data in normoglycaemic and impaired glucose tolerance populations indicate no effect of chromium on blood glucose levels (Figures 2 and 3). No serious concerns of study biases, inconsistency, imprecision or other methodological issues were identified.

Reference	Participant	Interventions[1]	Potential Confounders	Results
Brown 1986	63 yo F with gangrenous distal small bowel and cecum	IV $CrCl_3$ with TPN (200 µg/d, 2 weeks)	• TPN for last 7 months (1700 glucose calories and 85 g protein/d) • Insulin given (10-30 U/d)	• Plasma Cr unchanged; improvements in serum glucose and exogenous insulin requirement after supplementation
Freund 1979	45 yo F with mesenteric thrombosis; bowel resection	IV $CrCl_3$ with TPN (150 µg/d for 16 d)	• TPN initiated at 3000-4000 calories/d, 2000 calories/d after 4 months • Insulin initiated (20-30 U/d)	• Blood glucose decreased after Cr • Exogenous insulin requirement decreased after Cr.
Jeejeebhoy 1977	40 yo F with mesenteric thrombosis; complete enterectomy	IV $CrCl_3$ with TPN (250 µg/d for 2 weeks)	Symptom free for 3.5 y from start of TPN. 45 U/d insulin required before start of Cr treatment	• Improved fraction rate of glucose clearance in IVGTT after Cr. • Exogenous insulin not required after Cr.
Tsuda 1998	35 yo M with idiopathic intestinal pseudo obstruction	IV Cr with TPN, form not specified (200 µg/d for 2 weeks)	TPN for 13 years; 500 g glucose, 10% amino acids, electrolytes, multivitamin and essential elements (Fe, Zn, Mn, Cu, I)	• Improved plasma glucose after Cr • No urinary sugar detected after Cr. • Improved insulin secretion in IVGTT. • Serum Cr increased.
Verhage 1996	40 yo M with Crohn's disease; multiple bowel resections	IV $CrCl_3$ with TPN (250 µg/d for 2 weeks)	• TPN, unspecified duration (max 11 y?), last 6 months receiving ~ 15 µg Cr as TPN contaminant • Requires insulin • On prednisone for the last 10 y	• Improved fractional rate of glucose clearance in IVGTT after Cr • Increased serum Cr after Cr treatment

Table 1. Summary of study characteristics and findings for included studies using intravenous chromium interventions. [1]dose of chromium treatment given in elemental Cr

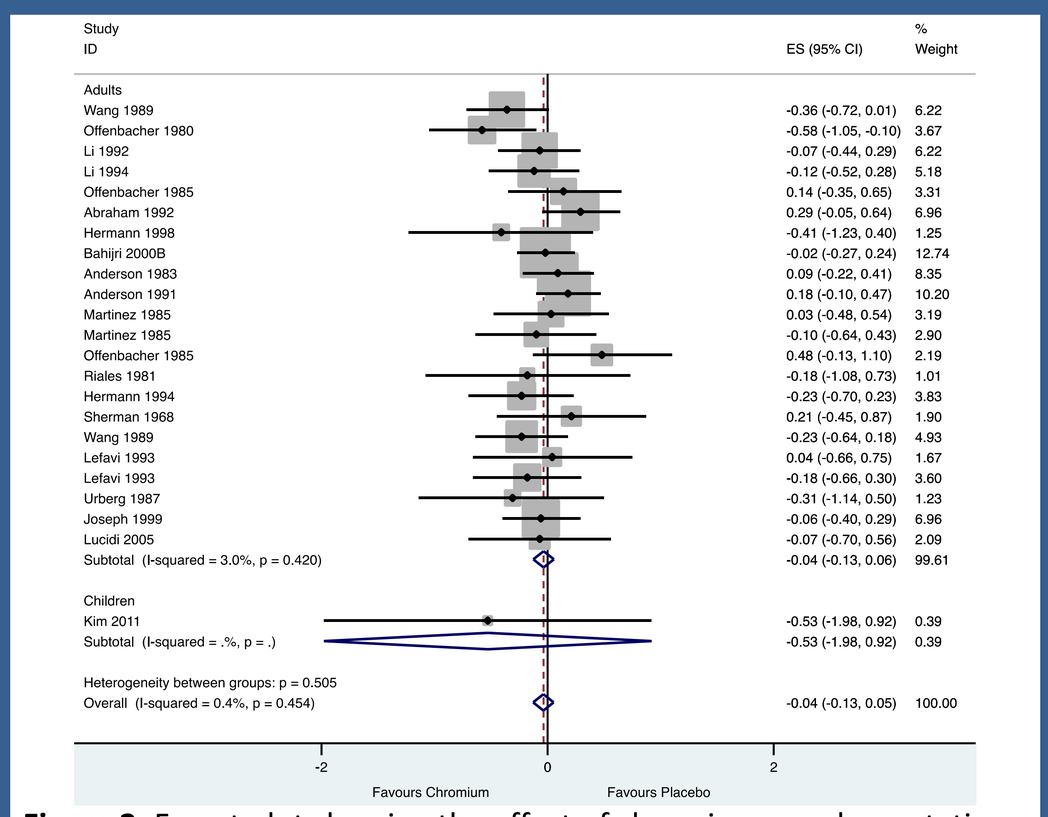

Figure 2. Forest plot showing the effect of chromium supplementation on fasting blood glucose in normoglycaemic population.

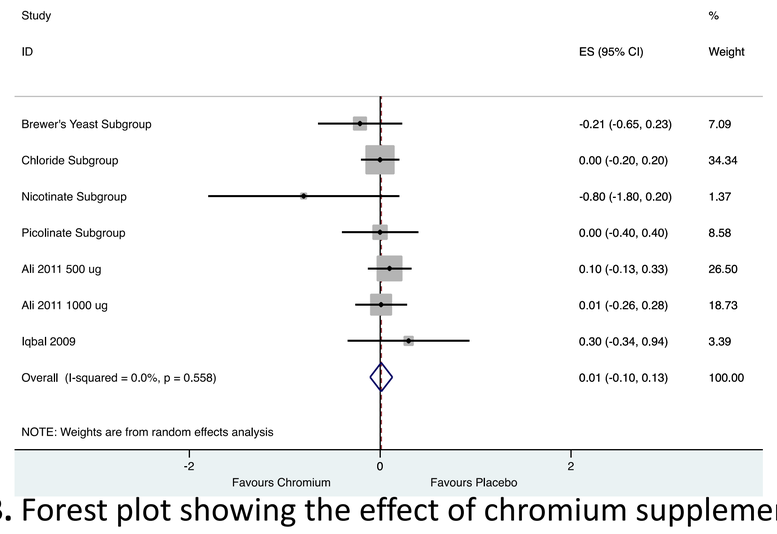

Figure 3. Forest plot showing the effect of chromium supplementation on fasting blood glucose in populations with glucose intolerance.

Conclusion

The results presented in the chromium deficient population could not be generalised to the general population; furthermore, chromium was administed intravenously which cannnot be extrapolated to represent a food-health relationship. We considered the relationship between dietary chromium and blood glucose levels in a chromium deficient population to be not assessable at this time. In the free-living populations, meta-analyses indicate no effect of chromium on blood glucose levels. However the studies were of relatively short duration and so no conclusions can be drawn on longer adminstrations. Therefore, we concluded that there is a 'Moderate' degree of certainty for no relationship between chromium intake and blood glucose levels in both normoglycaemic and impaired glucose tolerance populations.

Full report available at: http://www.foodstandards.gov.au/publications/Pages/Systematic-review-of-the-evidence-for-a-relationship-between-chromium-and-glycaemic-control.aspx