THE ROLE OF ZINC IN CHRONIC DISEASE

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Submitted for the Degree of Doctor of Philosophy at the University of Newcastle, Newcastle Australia

Submitted August 2014

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Declaration

The thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University’s Digital Repository, subject to the provisions of the Copyright Act 1968.

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Thesis by publication statements

I hereby certify that this thesis is submitted in the form of a series of publications of which I am first author. I have included as part of the thesis a written statement from each co-author; and endorsed by the Deputy Head of Faculty (Research), attesting to my contribution to the joint publications.

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Acknowledgements

I have been very privileged to be surrounded by supportive and caring colleagues over the past 4 years. There are a number of people who I wish to thank.

Firstly, thank you to my supervisors, Dr. Abul Hasnat Milton, Mark McEvoy and Professor John Attia. Milton- your support and encouragement during this time has been extremely helpful. Thank you for your patience, understanding and direction at all times. Mark- thanks you for your guidance, friendship, openness, and persistent faith in me over the years. John- you have been a constant source of knowledge, and this work has been made immeasurably better by the things that you have taught me, not only that but I have also learnt a lot about humility from you and I thank you for that. I couldn’t have hoped for more supportive supervisors.

My sincere thanks belong to all the co-authors for collaboration, the Hunter Community Study and the Australian Longitudinal Study of Women’s Health for providing access to the data and to all the men and women who took part in these studies, as researchers or as participants for without them this study won’t have been possible.

To my friends, I would like to say thank you once again for all your support and help during my PhD years and in finishing this thesis. Without any names being taken, you all know who you are; I appreciate every helping hand you all have extended towards me. Thank you for always being there for me.

Lastly, I would like to thank my amazing parents and siblings who believed in me, encouraged me and for their prayers, unconditional love and support.
List of publications


List of additional publications with relevance to this thesis

Statement of Contribution of Authors

We the undersigned co-authors attest that the research higher degree candidate Khanrin Phungamla Vashum contributed to conceptualization of the idea, study design, analyzed and interpreted the data, and developed all of manuscript included in this ‘thesis by publication’.

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# Table of contents

Declaration.............................................................................................................. ii
Thesis by publication statements........................................................................... iii
Acknowledgements ............................................................................................... iv
List of publications................................................................................................ v
Statement of Contribution of Authors .................................................................. vii
List of figures and tables ....................................................................................... xiii
Synopsis.................................................................................................................. 1

Section 1  Overview................................................................................................... 4
Chapter 1 Background, aims and structure of thesis............................................. 4
  1.1 Background and Rationale ............................................................................ 4
  1.2 Aims and Hypotheses .................................................................................. 5
  1.3 Structure of this thesis ................................................................................ 5
    1.3.1 Section 1 (Chapters 1 to 2): ................................................................. 6
    1.3.2 Section 2 (Chapters 3 to 6): ................................................................. 6
    1.3.3 Section 3 (Chapter 7): ........................................................................ 6
  1.4 Candidate’s contribution for this thesis and to the peer-reviewed publications originating from PhD study .......................................................... 6

Chapter 2 Brief literature Review ........................................................................ 9
  2.1 Search Strategy ........................................................................................... 9
  2.2 Current evidence on burden of chronic disease.......................................... 10
    2.2.1 Burden of Type 2 Diabetes .................................................................. 13
    2.2.2 Burden of Depression ......................................................................... 14
    2.2.3 Burden of Cardiovascular Disease ...................................................... 15
  2.3 Determinants of chronic disease .................................................................. 17
  2.4 Role of diet in chronic disease .................................................................... 20
  2.5 Zinc ............................................................................................................. 22
    2.5.1 What is zinc and where do we get it? .................................................. 23
    2.5.2 Recommended value of dietary zinc intake ........................................ 24
    2.5.3 Overview of zinc absorption and factors influencing it ...................... 26
    2.5.4 Role of zinc in human health ............................................................... 30
  2.6 Summary ...................................................................................................... 33
  2.7 References.................................................................................................... 34

SECTION 2 ASSOCIATIONS.................................................................................. 44
Chapter 3 Serum zinc and HOMA parameters .................................................. 44
  3.1 Is Serum Zinc Associated with Pancreatic Beta Cell Function and Insulin Sensitivity in Pre-Diabetic and Normal Individuals? Findings from the Hunter Community Study ........................................................................................................... 44
    3.1.1 Abstract .............................................................................................. 44
    3.1.2 Introduction ......................................................................................... 45
    3.1.3 Methods ............................................................................................. 47
      3.1.3.1 Classification of diabetic status ..................................................... 47
      3.1.3.2 Measurement of serum zinc and serum insulin ......................... 48
      3.1.3.3 Calculation of HOMA parameters ............................................. 48
3.1.3.4 Measurement of other exposure variables ........................................... 48
3.1.3.5 Statistical analysis ................................................................................. 49
3.1.4 Results ........................................................................................................ 50
3.1.5. Discussion .................................................................................................. 57
  Acknowledgments ............................................................................................... 60
  Author Contributions .......................................................................................... 60
3.1.6 References ................................................................................................... 61

Chapter 4 Dietary zinc and type 2 diabetes ............................................................. 65
4.1 Is dietary zinc protective for type 2 diabetes? Results from the Australian
longitudinal study on women’s health ................................................................. 65
  4.1.1 Abstract ...................................................................................................... 65
  4.1.2 Background ................................................................................................ 66
  4.1.3 Methods ..................................................................................................... 67
    4.1.3.1 Dietary assessment ............................................................................. 68
    4.1.3.2 Ascertainment of type 2 diabetes ...................................................... 69
    4.1.3.3 Measurement of non-dietary factors .................................................. 69
    4.1.3.4 Statistical analysis .............................................................................. 70
  4.1.4 Results ........................................................................................................ 71
  4.1.5 Discussion ................................................................................................... 72
  4.1.6 Conclusions ............................................................................................... 80
    Abbreviations .................................................................................................... 81
    Competing interests ........................................................................................... 81
    Authors’ contributions ...................................................................................... 81
    Acknowledgments .............................................................................................. 81
  4.1.7 References .................................................................................................. 82

Chapter 5 Zinc and depression ................................................................................. 85
5.1 Dietary zinc is associated with a lower incidence of depression: Findings from
two Australian cohorts ......................................................................................... 85
  5.1.1 Abstract ...................................................................................................... 85
  5.1.2 Introduction ................................................................................................ 86
  5.1.3 Methods ..................................................................................................... 88
    5.1.3.1 The Hunter Community Study (HCS) .............................................. 88
    5.1.3.2 Dietary assessment for HCS ............................................................... 89
    5.1.3.3 The Australian Longitudinal Study on Women’s Health (ALSWH) .... 89
    5.1.3.4 Dietary assessment for ALSWH ....................................................... 90
    5.1.3.5 Ascertainment of depression in HCS and ALSWH ....................... 90
    5.1.3.6 Measurement of non-dietary factors ................................................. 91
    5.1.3.7 Statistical analysis .............................................................................. 92
  5.1.4 Results ........................................................................................................ 92
  5.1.4.1 The Hunter Community Study ............................................................ 93
  5.1.4.2 The Australian longitudinal study on women’s health .................... 98
  5.1.5 Discussion .................................................................................................. 99
  5.1.6 Conclusion ..................................................................................................103
    Role of funding source ......................................................................................103
    Conflict of interest ...........................................................................................103
    Acknowledgements ..........................................................................................103
  5.1.7 References ................................................................................................105
List of figures and tables

List of Tables

Chapter 1

Table 1 Candidate’s Contributions to the Study, p. 8

Chapter 2

Table 1 Adults zinc intake recommended by National Health and Medical Council (NHMRC), Australia, p. 24
Table 2 Nutrient reference values uses by National Health and Medical Council (NHMRC), Australia, p. 25

Chapter 3

Table 1: Baseline characteristics by participants fasting blood glucose status, p. 52
Table 2: Laboratory findings and Homeostasis Model Assessment (HOMA) using for beta cell efficiency in normal and pre-diabetic groups, p. 54
Table 3: Adjusted linear regression analysis for HOMA parameters in participants with normal fasting glucose, p. 55
Table 4: Adjusted linear regression analysis for HOMA parameters in pre-diabetic participants, p. 56

Chapter 4

Table 1: Characteristics of subjects at survey 3 by quintile of energy-adjusted zinc, p. 74
Table 2: Stepwise approach to examine energy-adjusted zinc as an independent predictor of a new diagnosis of diabetes, p. 75
Table 3: Stepwise approach to examine zinc/iron ratio as an independent predictor of a new diagnosis of diabetes, p. 76

Chapter 5

Table 1: Univariate association between baseline characteristics and quintile of energy-adjusted zinc in both cohorts, p. 95
Table 2: A range of results from logistic regression models with incident depression at follow up as the outcome for HCS, p. 96
Table 3: A range of results from logistic regression models with incident depression at survey 5 as the outcome for ALSWH, p. 97

Chapter 6

Table 1: Characteristics of subjects at baseline (survey 3) by quintile of energy-adjusted zinc, p. 117
Table 2: Stepwise approach to examine energy-adjusted zinc as an independent predictor of a new diagnosis of cardiovascular disease, p. 119

Table 3: Stepwise approach to examine zinc/iron ratio as an independent predictor of a new diagnosis of cardiovascular disease, p. 120

List of figures

Chapter 2

Figure 1: Proportion of global NCD deaths under the age of 70, by cause of death, 2008 adapted from WHO global report 2010, p. 11

Figure 2: Proportional mortality (% of all deaths, all ages) in Australia. Adapted from WHO country profile 2011. NCDs are estimated to account for 90% of all deaths, p. 13

Figure 3: Relationship between risk factors and chronic disease, p. 17
Synopsis

This thesis by publication is composed of a background, rationale & aims, brief literature review, four papers, and a final chapter providing conclusions. All but one of the papers relates to prospectively investigating the role of dietary zinc in chronic disease, which has been examined inadequately in the literature. At this stage of the thesis, three of the four papers have been accepted for publication in peer-reviewed journals. The final paper has been currently submitted to a peer-reviewed journal that is internationally recognised.

Chapter 1 outlines the background, structure of the thesis and describes the rationale and aims of this research.

Chapter 2 provides a summary of the general literature on the current understanding of the role of zinc in normal human physiology and chronic disease in particular. This chapter does not review literature specific to each health outcome investigated, which is presented and discussed in each of the chapters dealing with these health outcomes.

Chapter 3 (Paper 1), “Is Serum Zinc Associated with Pancreatic Beta Cell Function and Insulin Sensitivity in Pre-Diabetic and Normal Individuals? Findings from the Hunter Community Study” reports the association between serum zinc concentration and Homeostasis Model Assessment (HOMA) parameters cross-sectionally in a random sample of 452 older community-dwelling men and women in Newcastle, NSW, Australia. HOMA parameters were found to be significantly different between normoglycaemic and prediabetes groups (p<0.001). In adjusted linear regression, higher serum zinc concentration was associated with increased insulin sensitivity (p = 0.01) in the prediabetic group and a significant association between smoking and worse insulin sensitivity was also observed. This paper has been published in PLOS ONE.

Chapter 4 (Paper 2), “Is dietary zinc protective for type 2 diabetes? Results from the Australian longitudinal study on women’s health,” reports the longitudinal association of dietary zinc with incident type 2 diabetes in 8921 women, aged 50-55 years at baseline over 6-years of follow-up. 333 incident cases of type 2 diabetes were identified at the end of follow-up and after adjustment for dietary and non-dietary factors, the
highest quintile of dietary zinc intake had almost half the odds of developing type 2 diabetes (OR = 0.50, 95% C.I. 0.32–0.77) compared with the lowest quintile. Similar findings were observed for the zinc/iron ratio; the highest quintile had half the odds of developing type 2 diabetes (OR = 0.50, 95% C.I 0.30-0.83) after adjustment of covariates. This paper has been published in BMC Endocrine Disorders.

Chapter 5 (Paper 3), “Dietary zinc is associated with a lower incidence of depression: Findings from two Australian cohorts” reports the longitudinal association of dietary zinc with incident depression in two large Australian cohort aged 50 and above over 6-years of follow-up. Both studies showed that low dietary zinc intake is associated with a greater incidence of depression in both men and women, after adjusting for potential confounders. Compared to those with the lowest zinc intake, those with the highest zinc intake had significantly lower odds of developing depression with a reduction of about 30–50%. This paper has been published in Journal of Affective Disorders.

Chapter 6 (Paper 4), “Prospective Study of Dietary Zinc Intake and Risk of Cardiovascular Disease in Women,” reports the longitudinal association of dietary zinc and cardiovascular disease (CVD) over 6-years of follow-up in a cohort of women aged 50-55 years at baseline. The study showed that risk of CVD increases with increased intake of dietary zinc. Compared to those in the lowest quintile of zinc intake those with in the highest quintile of zinc intake had significantly higher odds of developing CVD (OR= 1.67, 95% CI 1.08, 2.62) at the end of the follow-up. The same finding was also observed between energy-adjusted zinc to iron ratio and risk of developing CVD.

This has been submitted to the ‘Nutrition, Metabolism & Cardiovascular Diseases’ journal in July 2014.

Conclusions (Chapter 7). This program of research provided formative assessment of the potential role of dietary zinc in the following chronic diseases: Type 2 diabetes, depression and cardiovascular diseases. Given that this thesis studies were carried out in an Australian population, additional prospective cohort studies in other populations are needed to support the causal relationship between dietary zinc and these health outcomes. Hence, research that employs a longitudinal design, and rigorous
randomized controlled trials aimed at determining the efficacy of zinc in the prevention of chronic disease are needed. Furthermore, studies looking into the precise role and mechanisms for the effects of zinc compared to other essential nutrients from diet are needed to establish and reinforce the importance of dietary zinc in this chronic disease and other diseased state.