DIET AND SLEEP IN AUSTRALIAN

MIDDLE AGED AND ELDER MEN

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ABSTRACT

Optimal sleep duration and quality sleep are an important cornerstone for good health. Poor sleep can lead to a series of adverse consequences in metabolic and immune systems, as well as in mortality. Research into the effects of diet on sleep have mainly focused on single macronutrients and laboratory studies. Not yet explored are the complex interactions between dietary intake and chronic disease, psychosocial and lifestyle factors in relation to sleep at the population level.

This thesis aims to investigate the complexity of the association between dietary factors and sleep outcome (objective and subjective measures) middle aged and elderly Australian men. Data used in the thesis were from the Men Androgen Inflammation Lifestyle Environment and Stress (MAILES) study, established to determine the explanatory variables, and help with treatment and preventive measures, for the development of chronic diseases in men.

The studies undertaken in this thesis firstly examined the association between macronutrients intake and the risk of sleep apnoea and self-reported sleep symptoms in men aged 35-80 years old. This study found that compared with the lowest quartile of fat intake, the highest quartile was associated with increased risks of daytime sleepiness and sleep apnoea events during the night. No associations were observed between carbohydrate and protein and sleep parameters.

The studies undertaken secondly determined dietary patterns in the same population, and explored the association between these dietary patterns and sleep parameters. Three dietary patterns were identified: the prudent pattern that is characterized by fruits, vegetables and legumes and the western pattern that is characterized by processed meat, snacks, red meat and take-away foods, and the mixed pattern that is a combination of these two patterns. The

prudent pattern is associated with faster sleep onset, but no other associations were found between dietary patterns and sleep outcomes.

Dietary effects on inflammation have been widely studied, but no studies have linked dietary inflammation with sleep disorders. The final study examined the association between nutrient patterns and inflammation, as well as the interactions between nutrient patterns and obstructive sleep apnoea (OSA), lifestyle factors, and chronic diseases. An animal-sourced pattern (characterized by animal protein, cobalamin, cholesterol and omega-6) was positively associated with inflammation, while a plant-sourced pattern (characterized by beta-carotene, vitamin A, lutein and zeaxanthin) was inversely associated with inflammation. The association between the plant-sourced pattern and CRP was stronger in participants with sedentary lifestyle, high level of OSA, but without diabetes or dyslipidaemia. No associations were found between the vitamin B and folate pattern (characterized by total folate, thiamine, riboflavin and niacin) and inflammatory markers.

These studies confirmed the associations between dietary factors and sleep parameters at the population level. A general low fat and plant-based diet may improve sleep. In addition, a comprehensive understanding among diet, sleep disorders and inflammation and chronic diseases is highlighted. These findings have significant implications in public health and clinical management of chronic inflammation.

DECLARATION

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, 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. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of The University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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RESEARCH PRESENTATIONS

- **Cao Y,** Wittert G, Taylor A. W, & Shi Z. (Oral Presentation): *Dietary pattern and sleep: cross-sectional associations in a cohort of community dwelling men.* **Adelaide Sleep Retreat, University of South Australia, Adelaide, 2014**

- **Cao, Y.**, Wittert, G., Taylor, A. W., Adams, R., & Shi, Z. (Poster presentation): *Associations between Macronutrient Intake and Obstructive Sleep Apnoea as Well as Self-Reported Sleep Symptoms: Results from a Cohort of Community Dwelling Australian Men.* **12th Asian Congress of Nutrition, Yakohama, Japan, 2015**

- **Cao Y,** Wittert G, Taylor A. W., Adams R, & Shi, Z. (Oral presentation): *Nutrient patterns and chronic inflammation in a cohort of community dwelling middle-aged men.* **Freemasons Foundation Centre for Men's Health, Adelaide, 2015**

- **Cao, Y.**, Wittert, G., Taylor, A. W., Adams, R., & Shi, Z. (Poster presentation): *Associations between Macronutrient Intake and Obstructive Sleep Apnoea as Well as Self-Reported Sleep Symptoms: Results from a Cohort of Community Dwelling Australian Men.* **Research showcase, South Australian Health and Medical Research Institute, Adelaide, 2015**

- **Cao Y,** Wittert G, Taylor A. W., & Shi Z. (Oral & Poster presentation): *Dietary pattern and sleep: cross-sectional associations in a cohort of community dwelling men.* **Sleep Down Under, Melbourne, 2015**

- **Cao Y,** Wittert G, Taylor A. W., Adams R, & Shi, Z. (Poster presentation): *Nutrient patterns and chronic inflammation in a cohort of community dwelling middle-aged men.* **38th ESPEN Congress, Copenhagen, Denmark, 2016**

MEDIA COVERAGE

- Fatty diet linked to daytime sleepiness, SBS the world news, 20 April, 2016

- This may be why you are always sleepy, Herald Sun, 20 April, 2016

- University of Adelaide research suggests a fatty diet could be linked to sleep disorders in men, The (Adelaide) Advertiser, 20 April, 2016

- A high-fat diet may lead to daytime sleepiness, New York Times/Well/Eat, 21 April, 2016

- New reason to eat well, Network 10, Adelaide (TV interview), 21 April, 2016

- Too much fat could short circuit your brain's sleep cycle, Medical Daily, 27 April, 2016

- Radio interview, Adelaide 891 ABC, 22 April, 2016

- Radio interview, Sydney 2UE, 25 April, 2016

ABBREVIATIONS

AHI   Apnoea-Hypopnea Index

ATC   Anatomical Therapeutic Chemical

BDHQ   Brief-Type Self-Administered Diet History Questionnaire

BMI   Body Mass Index

CAD   Coronary Artery Disease

CATI   Computer assisted telephone interview

CHF   Congestive Heart Failure

CRP   C-Reactive Protein

CVD   Cardiovascular Disease

DIS   Difficulty In Initiating Sleep

DMS   Difficulty In Maintaining of Sleep

DQES   Diet Questionnaire for Epidemiological Studies

EEG   Electroencephalogram

EOG   Electrooculogram

EMG   Electromyogram

ECG   Electrocardiogram

ESS   Epworth Sleepiness Scale

FAMAS   Florey Adelaide Male Ageing Study

FFQ   Food frequency questionnaire

HDL	High-density lipoprotein
IL-1	Interleukin-1
IL-6	Interleukin-6
LDL	Low-density lipoprotein
LV	Left Ventricle
GI	Glycaemic Index
GL	Glycaemic Loading
MAILES	Men Androgen Inflammation Lifestyle Environment and Stress
MLR	Multinominal Logistic regression
NHANES	National Health and Nutrition Examination Survey
NWAHS	North West Adelaide Health Study
OR	Odds Ratio
OSA	Obstructive Sleep Apnoea
PCA	Principal Component Analysis
PSG	Polysomnography
PSQI	Pittsburg Sleep Quality Index
RRR	Reduced Rank Regression
SES	Socioeconomic Status
SOL	Sleep Onset Latency
STOP	Snore, Tiredness during daytime, Observed apnoea and high blood Pressure

TNF	Tumour Necrosis Factor
TST	Total Sleep Time
UK	United Kingdom
USA	United States of America
WASO	Wake After Sleep Onset