

# Dietary Patterns and Beta–Amyloid Deposition in Ageing Australian Women

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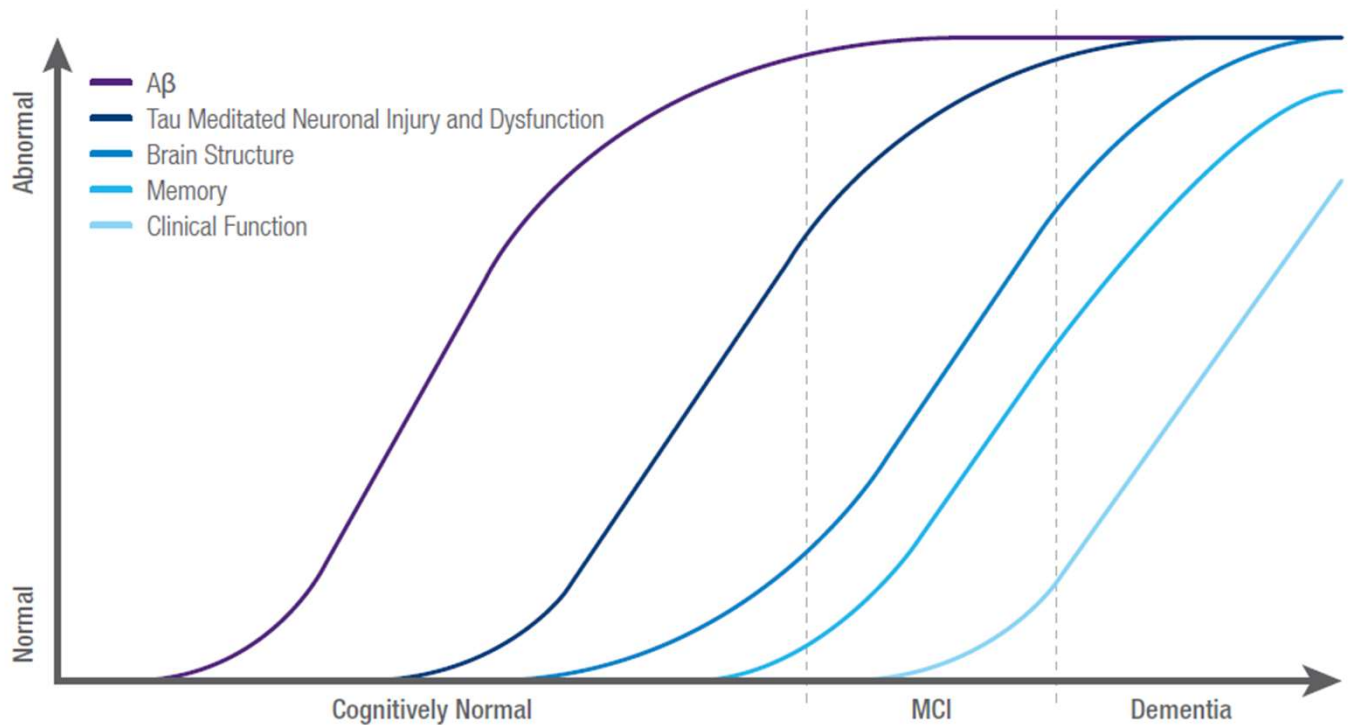
Alzheimer's Disease International Conference  
196c, McCormick Place West, Chicago, USA  
Saturday July 28, 2018: 2:00pm – 3:30pm



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# BACKGROUND I



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[1] Jack *et al.*



## BACKGROUND II

- Diet and nutrition may offer potential for non-pharmacological prevention in Alzheimer's disease (AD)
  - Consistently, a high intake of fruit, vegetables, cereals and legumes and low intake of meat, high-fat dairies and sweets are associated with a lower risk of AD



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[1] Merrill *et al.* [2] Taylore *et al.* [3] Bayer-Carter *et al.* [4] Gu *et al.*

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  - Consistently, a high intake of fruit, vegetables, cereals and legumes and low intake of meat, high-fat dairies and sweets are associated with a lower risk of AD
- Epidemiological evidence indicates an association between healthy diets and AD biomarkers
  - Higher adherence to Mediterranean diet (MeDi) <sup>1</sup>
  - Low glycemic index foods <sup>2, 3</sup>
  - Higher consumption of  $\omega$ -3 polyunsaturated fatty acids <sup>4</sup>



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[1] Merrill *et al.* [2] Taylore *et al.* [3] Bayer-Carter *et al.* [4] Gu *et al.*

## BACKGROUND III

- Evidence indicates an association between diet and AD
  - Systematic review by Yusufov *et al*/found 50/64 studies found an association between diet and AD incidence/prevalence <sup>1</sup>
    - Sig. findings in 10/12 MeDi studies
    - Contribution of macronutrients
    - Vitamin C/E,  $\beta$ -carotene



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[1] Yusufov *et al*. [2] Hill *et al*. (submitted for publication)

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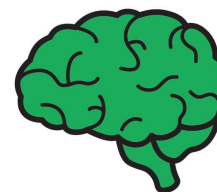


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## Reduced burden



- Associated with healthy type dietary pattern
- In brain, CSF & plasma
- Tau & A $\beta$

## Increased burden

- Associated with high-glycemic/ high-saturated fat diet
- In brain & CSF
- Tau & A $\beta$



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[1] Yusufov *et al*. [2] Hill *et al*. (submitted for publication)

## BACKGROUND IV

- Women are more likely than men to develop AD<sup>1</sup>
  - Higher penetrance for APOE 4 allele<sup>2</sup>
  - More likely to progress from mild cognitive impairment (MCI) to AD<sup>2</sup>
  - 1.5 times more likely to develop AD than men<sup>3</sup>



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[1] Pike *et al.* [2] Altmann *et al.* [3] Viña *et al.*



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  - 1.5 times more likely to develop AD than men<sup>3</sup>
- Male and mixed cohort studies predominate the research
  - No study has investigated the diet-AD biomarker relationship in women only



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[1] Pike *et al.* [2] Altmann *et al.* [3] Viña *et al.*

# AIM

- We aimed to identify dietary patterns using an *a priori* approach and investigate their associations with cerebral beta-amyloid ( $A\beta$ ) deposition in healthy ageing Australian women



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# WHAT'S A PRIORI & A POSTERIORI?

- These are methods of dietary pattern analysis
- An *a priori* approach is research driven
  - Use scores or indices
  - How well a diet fits with an 'ideal' pattern
  - Mediterranean diet, MeDi, Aus-MeDi
- An *a posteriori* approach is data driven
  - Use statistical models
  - To define a dietary pattern within a population



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# WHAT'S A PRIORI & A POSTERIORI?

- An example. Let's say everyone completed a 24hr FFQ
- An *a priori* approach is research driven
  - Research has shown blueberries are healthy
  - 1 point for >10 blueberries in last 24 hrs



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- An example. Let's say everyone completed a 24hr FFQ
- An *a priori* approach is research driven
  - Research has shown blueberries are healthy
  - 1 point for >10 blueberries in last 24 hrs
- An *a posteriori* approach is data driven
  - Two dietary patterns emerged
    - People that went to the NDRI
    - People that went to Pequod's



**Dementia  
Innovation  
Readiness  
Index**



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# METHOD I

- Study Population
  - 2012 follow-up of Women's Healthy Ageing Project (WHAP)<sup>1</sup>
  - Physical, lifestyle, sociodemographic, cognitive, neuropsychological, psychological, biomarker measures since 1991
- Diet
  - Validated food frequency questionnaire: Dietary Questionnaire for Epidemiological Studies Version 2 (DQES v2)<sup>2</sup>
  - Energy, nutrient, food intake calculated by Cancer Council of Victoria
  - Dietary patterns extrapolated from food groupings using iterated principal component analysis



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[1] Szoeké *et al.* [2] Giles *et al.*

## METHOD II

- Imaging
  - A $\beta$  deposition was measured via in vivo F-18 Florbetaben positron emission tomography (PET)
  - Neocortical SUVR, a global index of A $\beta$  burden, is expressed as the average SUVR of the area-weighted mean
- Covariates
  - Age (in years), education (in years), body mass index (BMI), cognition (CERAD Savings1), energy intake (kJ/day), presence of APOE  $\epsilon$ 4 allele
- Data Analysis
  - Generalized linear models (GLM) were used to assess associations between dietary patterns scores and A $\beta$  deposition



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[1] Welsh *et al.*

# RESULTS I

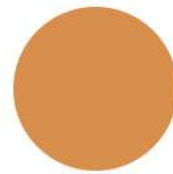
- Four dietary patterns were identified
  - Named due to factor loadings



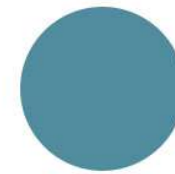
**High-Fat**



**Mediterranean**



**Junk Food**



**Low Fat**



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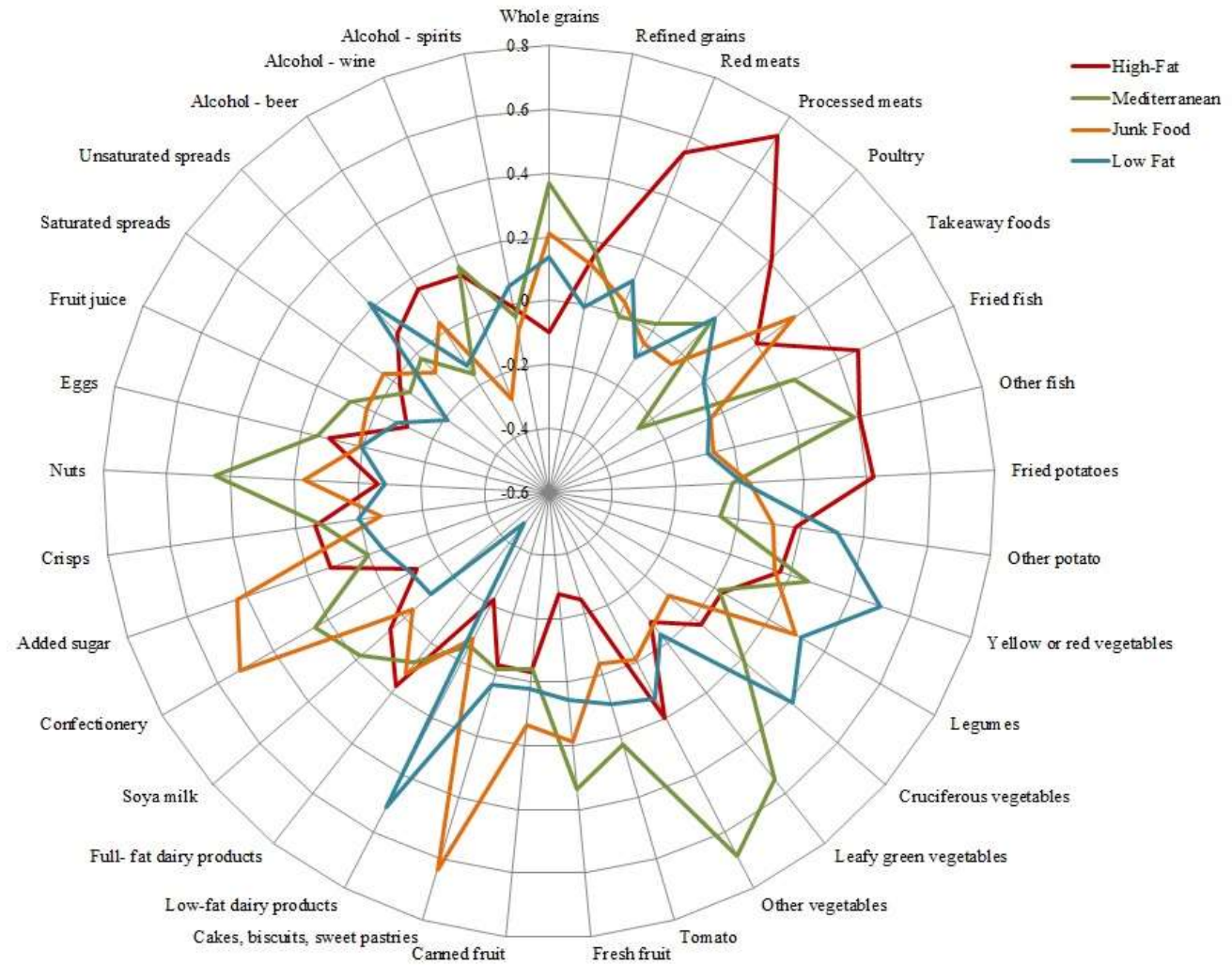
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# RESULTS II

- High-Fat
- Mediterranean
- Junk Food
- Low Fat



## RESULTS III

	High-Fat (n = 24)	MeDi (n = 31)	Junk Food (n = 24)	Low Fat (n = 35)	Total (n = 115)
<b>Age</b> (in years)	69.79 ± 2.42	69.45 ± 2.23	70.41 ± 3.19	69.57 ± 2.70	69.76 ± 2.63
<b>Education</b> (in years)	12.88 ± 3.67	14.10 ± 3.87	11.50 ± 2.96	12.63 ± 3.36	12.84 ± 3.57
<b>BMI</b> (kg/m <sup>2</sup> )	28.58 ± 6.75	27.43 ± 5.48	27.14 ± 5.58	29.29 ± 4.26	28.18 ± 5.46
<b>Energy</b> (kJ/day)	5443.46 ± 2116.50	4809.79 ± 1145.51	6035.40 ± 1993.21	4677.26 ± 1242.79	5160.53 ± 1679.03
<b>APOE Positive n</b> (%)	9 (37.5%)	9 (29.0%)	9 (37.5%)	10 (28.57%)	37 (32.46%)
<b>CERAD Saving</b> (%)	72.93 ± 18.08	72.97 ± 31.07	65.57 ± 28.76	63.34 ± 28.62	68.45 ± 27.52
<b>PET SUVR</b> (Raw)	1.1296 ± 0.1539	1.0835 ± 0.1427	1.2150 ± 0.2458	1.1300 ± 0.2336	1.1352 ± 0.2026
<b>PET SUVR</b> (Transformed)	0.8185 ± 0.1770	0.8829 ± 0.1646	0.7389 ± 0.2174	0.8446 ± 0.2043	0.8273 ± 0.1959



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# RESULTS IV

	Coefficient	Std. Err.	p	C.I Lower	C.I Higher
High-Fat	-0.00705	0.04372	0.872	-0.09273	0.07864
Mediterranean	0.06390	0.04349	0.142	-0.02135	0.14915
<b>Junk Food</b>	-0.09740	0.04511	<b>0.031*</b>	-0.18582	-0.00898
Low-Fat	0.02338	0.03962	0.555	-0.05428	0.10103
Age (in years)	-0.00120	0.00702	0.864	-0.01495	0.01256
Education (in years)	0.00139	0.00502	0.781	-0.00845	0.01125
BMI	-0.00076	0.00326	0.816	-0.00714	0.00563
Energy (kJ/day)	-0.00001	0.00001	0.309	-0.00003	0.00001
<b>APOE Presence</b>	-0.10916	0.03919	<b>0.005*</b>	-0.18598	-0.03233
CERAD Savings Score	0.00125	0.00065	0.054	-0.00002	0.00252



# DISCUSSION I

- Adherence to the junk food dietary pattern was a significant predictor of cerebral A $\beta$  deposition
  - Controlling for age, education, BMI, energy intake, APOE, cognition
  - No other dietary patterns displayed A $\beta$  associations



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[1] Taylor *et al.* [2] Bayer-Carter *et al.* [3] Hanson *et al.* [4] Baker *et al.*  
[5] Berti *et al.*

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- Contributes to growing body of evidence linking diet with AD
  - Adherence to a high glycemic diet linked to increased biomarker burden in brain<sup>1</sup> and CSF<sup>2,3,4</sup>
  - Another PCA found decreased amyloid deposition was associated with a dietary pattern characterised by higher consumption of omega-3 FAs, zinc, vitamin B12 and vitamin D<sup>5</sup>



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  - Another PCA found decreased amyloid deposition was associated with a dietary pattern characterised by higher consumption of omega-3 FAs, zinc, vitamin B12 and vitamin D<sup>5</sup>
- First to demonstrate a diet – AD biomarker relationship in a female only cohort



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## DISCUSSION II

- High consumption of sugar, carbohydrates, high glycemic foods are associated with impaired glucose metabolism<sup>1</sup>
- Disrupted glucose metabolism alters production and clearance of A $\beta$  and tau phosphorylation<sup>2</sup>
  - Insulin resistance<sup>3</sup> and type-2 diabetes<sup>4</sup> are risk factors for AD
  - In animal models:
    - High fat diet linked to increased brain A $\beta$ <sup>5,6,7</sup>
    - APOE isoforms shown to modulate glucose uptake and metabolism<sup>8</sup>



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[1] Livesey *et al.* [2] Sato *et al.* [3] Matsuzaki *et al.* [4] Huang *et al.* [5] Sparks *et al.* [6] Refolo *et al.* [7] Ho *et al.* [7] Keeney *et al.*



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  - In animal models:
    - High fat diet linked to increased brain A $\beta$ <sup>5,6,7</sup>
    - APOE isoforms shown to modulate glucose uptake and metabolism<sup>8</sup>
- We hypothesise the relationship observed between a high fat, high sugar diet and increased cerebral A $\beta$  deposition may be moderated by impaired glucose metabolism in this female cohort



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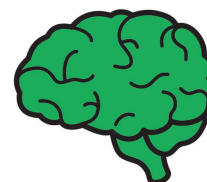


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# SUMMARY

- Previous research established diet – AD incidence relations, our systematic review investigated diet – AD biomarkers
- This study utilised principal component analysis to investigate diet– A $\beta$  relationships in healthy women at a greater risk for disease
- We found adherence to the junk food dietary pattern was a significant predictor of A $\beta$  deposition
- We hypothesize this relationship is due to impaired glucose metabolism
- Further longitudinal research is necessary, currently no published longitudinal diet–AD biomarker studies

## Reduced burden



- Associated with healthy type dietary pattern
- In brain, CSF & plasma
- Tau & A $\beta$

## Increased burden

- Associated with high-glycemic/ high-saturated fat diet
- In brain & CSF
- Tau & A $\beta$



Junk Food



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# ACKNOWLEDGEMENTS

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