Mediterranean diet and musculoskeletal health – latest findings and solutions

Professor Ailsa Welch

The relationship between the Mediterranean Dietary Pattern and musculoskeletal health in children, adolescents and adults

Dr Karen Murphy

A Mediterranean Diet supplemented with dairy improves blood pressure in ‘at risk’ women and men: outcomes of the Med Dairy Study

The relationship between the Mediterranean Dietary Pattern and musculoskeletal health in children, adolescents & adults

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Webinar, Melbourne, Australia, 21/11/2018
Introduction & overview

- Importance of the links between skeletal muscle, sarcopenia & bone health
- Relevance of the Mediterranean Dietary Pattern to musculoskeletal health
- Results & update of the systematic review
- Conclusions

Osteoporosis, sarcopenia & fractures

**Sarcopenia**: age-associated low skeletal muscle mass with low muscle strength and/or low physical performance

Increased risk of osteoporosis, frailty, falls & fractures

**Osteoporosis**: loss of bone density with age

NORMAL & OSTEOPOROTIC BONE

Prevention of fractures of key importance

Fractures
1 in 2 women > 50 Y
1 in 5 men > 50 Y

1 ALFONSO J. CRUZ-JENTOFT. Age and Ageing 2010; Revised 2018
• Loss of bone density, skeletal muscle mass & strength with age
• Continuum: gradual from age 30Y. Acceleration after 50Y
• Gender differences. Women steep decline at menopause
• Muscle - cross-sectional > 50 Y: mass between 1-2%/Y, force/strength 1%-3%/Y

1 ALFONSO J. CRUZ-JENTOFT Age and Ageing 2010; Revised 2018

Links between skeletal muscle & bone – two way interactions

Endocrine signals: reduced sex hormones IGF-1

Maintenance of gait, posture, prevention of falls

Number of publications linking osteoporosis & risk of fractures with low muscle mass, strength & sarcopenia

Tagliaferri C, Aging Res. Rev. 2015, Girolamo, DJ, JBMR, 2013, Curtis E, J Cell Physiol, 2015:
Prevalence & costs of osteoporosis, sarcopenia, frailty & fractures

- **Sarcopenia prevalence:**
  - community 1%-29% those > 60Y
  - long term care 14%-33% (Cruz-Jentoft AJ, Age Aging 2014; Ethgen O Calcif. Tiss. Int. 2017)

- **Costs $18.5B - 2004** (Kilsby A, Drug Aging 2017)
- **Sarcopenia is a risk factor for onset of frailty**
- **Frailty 25% in those > 80Y. 19.1% community - older adults, physically frail (Verlaan S, JAMDA, 2017)**
- ~ 50% walk unaided after hip fracture. Pain.

### Diet: shared modifiable lifestyle factor for muscle & bone

- **Vitamin D** *(diet + sun)*
- **Vitamin C** *
- **Carotenoids** *
- **Magnesium (Mg)** *
- **Potassium (K)** *
- **Dietary patterns**

**Bone density/ osteoporosis**

**Muscle mass, strength, sarcopenia**

**Protein**

**Calcium**

Maintenance of nitrogen balance – MPS/MPB


* recent/new research
Overview

- Importance of the links between skeletal muscle, sarcopenia, and bone health
- Relevance of the Mediterranean Dietary Pattern to musculoskeletal health
- Results & update of the systematic review
- Conclusions

Mediterranean Diet & musculoskeletal health

Dietary patterns, eg Mediterranean Diet
Foods eaten but effects of diet operate through the micronutrient & macronutrients. Synergy between foods/nutrients

Micronutrients: vitamin C, carotenoids, vitamin K, Mg, Ca, K

Micronutrients & protein:
- protein
- calcium
- vitamin D
Mediterranean Diet Scores used in epidemiology

Scores based on an original score devised by Antonia Trichopoulou (NEJM, 2003). Consists of 9 components:
- vegetables
- fruit
- legumes
- cereals
- fish
- meat
- dairy
- fat used in cooking/food preparation
- alcohol

Median intake for the population calculated
- +ve 1 point if above the median
- -ve 0 points if above the median for meat & dairy
- Alcohol 1 point:
  - Men 10g-50g/d
  - Women 5g-25g/d

Other scores have been derived since

Variability in food intake: north to south variation

Vegetable intake across Europe

EPIC (European Prospective Investigations into Cancer and Nutrition) (Agudo et al, PHN, 2002)
Introduction & overview

Importance of the links between skeletal muscle, sarcopenia & bone health

Relevance of the Mediterranean Dietary Pattern to musculoskeletal health

Results & update of the systematic review

Conclusions

Study design matters

Important to understand the true relationship between diet & disease

Impacts on the results from published studies

Bias/measurement error

For evidence for policy & practice:
  • Randomised Controlled Trials (RCT)
  • Prospective: measures: exposure at beginning & follow up outcomes with time

20/11/2018
The relationship between the Mediterranean Dietary Pattern and musculoskeletal health in children, adolescents & adults

• Systematic review (Craig J, et Al, Nutrition Reviews, 2017). Results + update more recent studies
• Reviewed skeletal & bone outcomes in:
  • children
  • adolescents
  • adults
• Reviewed to April 2016
• Study design: RCTs & prospective cohort studies

• We reviewed the Mediterranean Dietary Pattern scores – complex scoring system with large variability in use (Ruiz HR, Nut Hosp, 2015)
• A priori scores
• Antonia Trichopoulou (NEJM, 2003)
  • 8 core food categories:
  • Alcohol not core
  • Details in paper

Outcomes included in the systematic review

Muscle/sarcopenia
• Sarcopenia, dynapenia, myopenia incidence
• Direct measures of:
  • Skeletal muscle mass
  • Plus strength or physical performance

Bone/skeletal
• Fracture incidence
• Fracture risk score
• Osteoporosis/osteopenia incidence
• BMD, BMC
• Bone turnover markers
Reviewed 26 scores for assessing MD adherence

<table>
<thead>
<tr>
<th>No. scores</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>26</td>
</tr>
<tr>
<td>Veg</td>
<td>26</td>
</tr>
<tr>
<td>Fat</td>
<td>26</td>
</tr>
<tr>
<td>Meat</td>
<td>25</td>
</tr>
<tr>
<td>Fish</td>
<td>25</td>
</tr>
<tr>
<td>Legume</td>
<td>24</td>
</tr>
<tr>
<td>Cereal</td>
<td>24</td>
</tr>
<tr>
<td>Dairy</td>
<td>21</td>
</tr>
<tr>
<td>Alcohol</td>
<td>21</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

High variability in the scoring system /construction of scores. Vegetables – different combinations. Dairy scored positive or negative/ selected components /not scored.

A priori decision: aMED (alternative Mediterranean eating pattern)

Results

• N = 1738 papers searched & screened
• Found very few studies. Therefore, included an evidence map to show all the available evidence
• Number of studies
  • 15 evidence map
  • 2 studies met criteria for fracture risk
• 1 incident sarcopenia. Hong Kong (Chan R et al 2016)
  • Prospective cohort study. 4 year follow up (N=2948, > 65Y)
  • HR incidence per 1 unit increase in MD adherence:
    • Men - 0.98 (90.06-1.10), P=0.8.
    • Women – 0.96 (0.83-1.11, P=0.6) i.e. not significant
• No studies in children
Number of studies and nature of study designs for the outcomes in the SR or evidence map N=18

Some studies reported > 1 outcome

Forest plot of most adjusted hazard ratios for first fracture incidence associated with a 1 unit increment in MD adherence (on scale of 0-9), by fracture site (some 2 studies)

More recent SR (Malmir H E J Nutr 2018) quoted RR for Hip fractures in meta-analysis of 4 studies, RR 0.79 (0.72-0.87) i.e reduction of 21%. However of the 5 studies identified, the study by Feart was omitted from the meta-analysis (it showed no associations with the MD)
Relationship between the MD & risk factors for sarcopenia in women UK Twin cohort aged 18-79 years

• Investigated risk factors for sarcopenia and the MD
• Cross-sectional study in women 18-79Y
• Investigated the association between the MD & skeletal muscle mass (DXA) (fat free mass), grip strength & leg explosive power (LEP)
• Fat free mass as percentage FFM% (fat free mass/body weight)*100
• Food Frequency Questionnaire (FFQ)

• Quartiles – MDS score (Q1 0-3, Q2 4, Q3 5, Q4 6-9
• Robust cluster regression. Adjusted for: age, physical activity, smoking habit & other specific covariates. Plus protein intake

Fat free mass and leg explosive power in women by quartiles of the Mediterranean Diet Score (MDS)

Fat free mass - percentage
P < 0.001 - difference 1.0 % - 1.6 %

Leg explosive power - w/kg
P < 0.001 – difference 8.3 w/kg – 9.5 %

Mediterranean Diet Score: Q1 0-3 Q2 4 Q3 5 Q4 6-9

Adjusted values

Kelaiditi E et al, OI 2016
Further studies on the MD and musculoskeletal outcomes (since 2016)

**BONE DENSITY:** 1 Finland F 65-71Y, cross-sectional, no effect (Erkkila A, PHN, 2017).
1 China M + F. Association MD with hip BMD. 2.6% increase Q5 vs Q1 (Chen GD, Scientific Rep, 2016)

**FRACTURES:** 2 prospective studies. 1 Sweden M + F (71,333). 6% decrease in hip fracture with 1 unit increase in MED score (Byberg, JBMR, 2016). 1 Greece, Sweden and US (CHANCES Study) M + F (Benetou V, OI, 2018). 4% decrease in hip fracture with 2 unit increase in MD. NB same Swedish cohorts included in both studies. Dairy classified positively in ‘Byberg study’ and negatively in ‘Benetou Study’

**SARCOPENIA OR RISK FACTORS:** 1 China 40-75Y, cross-sectional (Tian H-Y, BJN, 2017). Increase in ALM with MD + 2.7% men, +1.1% women.

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- Conclusions
Summary: Mediterranean diet & musculoskeletal health

- As yet, insufficient evidence for beneficial effects of MD on risk of fractures and osteoporosis
- Even less evidence for sarcopenia
- More evidence needed for all age groups particularly children & adolescents
- The MD used in epidemiology is a very variable pattern due to regional differences in food intakes. This impacts on intakes of the nutrients within the pattern and so affects the findings from studies using the MD pattern
- Scoring of the MD may impact on protein and calcium intakes

Conclusions

- Need RCTs to determine the effect of the MD
- Healthy balanced diet important for bone & muscle health at all life stages, and for preventing fractures
- Physical activity. Encourage individuals & population approaches to keep active and maintain physical activity
- Encourage healthy eating patterns & follow healthy eating guidelines for bone & skeletal muscle health
Acknowledgements

• Dr Jean Craig
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• Dr Richard Hayhoe
• Will Appleyard MBBS student
• Dr Lee Hooper

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Thank you for listening
A Mediterranean diet supplemented with dairy improves blood pressure in ‘at-risk’ men and women: Outcomes of the MedDairy Study

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Mediterranean Dietary Patterns Team

On behalf of the MedDairy Study Team

Alexandra Wade, Courtney Davis, Kate Dyer, Jonathan Hodgson¹, Richard Woodman², Hannah Keage.

¹Edith Cowan University, WA.
²Flinders University, SA.

Mediterranean diet - a cure-all pattern?

Umbrella review of meta-analyses in 12.8 million subjects

- Overall mortality
- Cardiovascular diseases
- Coronary heart disease
- Myocardial infarction
- Cancer incidence
- Neurodegenerative diseases
- Diabetes

Dinu M et al 2017. MedDiet and multiple health outcomes: an umbrella review of meta-analyses of observational studies and randomised trials. EJCN.
Mediterranean diet (MedDiet) for cognition and cardiovascular health in the elderly

NHMRC #1050949

- 166 men and women aged 71 years (range 64-86 years)
- 6 month dietary intervention trial comparing MedDiet with habitual diet
- Dietitian led RCT, intervention delivered by dietitians, recipes and key foods were supplied
- CVD risk factors, weight and cognitive performance measured at the beginning and after 3 and 6 months

Flow Mediated Dilatation
1.3% higher [95%CI 0.2%, 2.4%, P=0.003]
(mean baseline adjusted diff. between groups at 6m)

Oxidative Stress (F2-Isoprostanes)

-107.6 (21.5) P<0.001**
-70.1 (22.1) P=0.002**

Systolic Blood Pressure

* diet*time interaction P=0.02

Where to next?

MedLey showed us that Australians can follow a traditional MedDiet for 6 months

- feasible
- older population
- significant CVD risk reduction

It doesn’t meet the NRV for calcium for Australians

Would this affect adoption of the pattern as a healthy dietary pattern?

Could it impact osteoporosis rates?

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**Dairy Foods and Calcium Recommendations**

<table>
<thead>
<tr>
<th>Dairy foods (serves/day)</th>
<th>Calcium (mg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mediterranean Diet Foundation</td>
<td>2</td>
</tr>
<tr>
<td>NHMRC</td>
<td>3-4</td>
</tr>
<tr>
<td>Australian Intakes</td>
<td>W: 741 / 674 M: 781 / 726</td>
</tr>
</tbody>
</table>

4.74 million Australians have poor bone health of which 22% have osteoporosis and 78% have osteopenia.

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A Mediterranean diet, supplemented with dairy foods (milk, cheese and yoghurt) to meet Australian dairy and calcium recommendations, was compared with a low-fat control diet on measures of cardiovascular risk.

**Primary outcome:** Home measured systolic blood pressure

**Secondary outcomes:** clinic measured blood pressure, fasting lipids, glucose, insulin, CRP, body composition, BMI and waist-to-hip ratio

Inclusion Criteria:
- 45-75 years with SBP >120mmHg, not taking antihypertensive medication plus 2 of the following risk factors for CVD:
  - BMI ≥ 25kg/m^2
  - Abdominal adiposity - WC >94cm for men >80cm for women
  - TC ≥ 5.5mM
  - TAG ≥ 2.0mM
  - LDL ≥ 3.5mM
  - HDL ≤ 0.9 for men ≤1.0 for women
  - Glucose 6.1-7.8mM
  - Family History of CVD or T2DM

Exclusion Criteria:
- Smoker
- Medical condition (CVD, angina, current or recent malignancies, renal, GI, respiratory disease, T2DM)
- Dietary intolerance or allergy impeding diet intervention adherence
- Taking medicinal levels of calcium
- Taking >1g n-3 LCPUFA

Methods

Design: Dietitian led, randomised, parallel crossover design (n=41)

Screening, consent & enrolment
Home BP
WFR

Week -1
Period 1
MedDairy
Low-fat
Washout
Period 2
Low-fat
MedDairy

* * * * *
* * * * *

Screening: questionnaire, BP, BMI, WC, fasted lipids, fingerprick glucose, MedDiet score
BP recorded at home week prior to intervention (3 measures x morning, afternoon, before bed)
*Outcomes measured
* Fortnightly 30’ visit with dietitian, collect foods, diet adherence scores, checklists, weight

Consort

Withdrawal prior to commencement n=3
Randomised n=44
Commenced n=41

Withdral
n=1
MedDairy
n=20
Low Fat
n=21
Withdrawal
n=2

Low Fat
n=19
MedDairy
n=19
Withdrawal
n=1

Completed
n=37

Power calculation required n=31 to complete.
90% retention rate
MedDairy Intervention

- 3 - 4 serves of dairy foods (e.g. milk, cheese, Greek yoghurt, custard) per day.
- Abundant use of extra virgin olive oil, MINIMUM of 1 tablespoon per day
- ≥3 serves of vegetables per day
- ≥2 – 3 serves of fresh fruit including 100% natural juices per day
- ≥3 serves of legumes per week
- ≥5 serves of nuts/seeds per week
- Select white meats (poultry with no skin) instead of red meat or processed meats
- Cook minimum twice per week with tomato, garlic and onion (Sofrito sauce)
- Usual drinkers have no more than 2 standard drinks per day
- Ad libitum consumption of nuts, eggs, fish, seafood, cheese, wholegrain cereals, wholegrain rice, pasta and bread, couscous

- Limit to ≤ once per week cured ham, red meat, chocolate
- Avoid refined carbohydrate including white rice, white bread, white flour
- Eliminate or drastically limit discretionary foods like: cream, spreads, cold meats, pate, duck, sugary beverages –baked goods, fried foods, takeaway foods, confectionary.


Food Hamper- MedDairy Group

Each fortnight:
- 1-2 bottles EVOO
- 14 tubs yoghurt
- 2 x 95g tins tuna
- 2 x 95g tins salmon
- 2 x 400g tins legumes
- 180g (6 x 30g) walnuts+ almonds+ hazelnuts (2:1:1)
- Cheese

Kind donations from Cobram Estate, Fonterra Group, Chobani, Simplot (Edgell & John West), Almond Board of Australia.
LowFat Diet Intervention

- Maintain your habitual dietary pattern but choose low fat foods
- Avoid high fat foods
- Swap regular fat foods for low-fat, reduced fat etc.
- Remove visible fat from meat, skim soups and casseroles of fat, avoid smearing spreads on crackers, bread etc.
- Purchase low fat foods
- Cook with less fat

Dietary Adherence Questionnaires

For MedDairy group only

<table>
<thead>
<tr>
<th>Foods and frequency of consumption</th>
<th>Y / N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do you use olive oil as your main cooking fat? (please circle Y or N)</td>
<td>Y / N</td>
</tr>
<tr>
<td>2. How much olive oil do you consume in a given day (including all used for frying, salads, non-dairy sauces, etc)? (please answer to intervals: 0 (almost never) – approximately 25 mL)</td>
<td></td>
</tr>
<tr>
<td>3. How many vegetable servings do you consume per day? (1 serving = 1 large salad or 1 cup salad or 1 medium salad)</td>
<td></td>
</tr>
<tr>
<td>4. How many fish servings (excluding pieces of fish and small 100g fish dishes) do you consume per day?</td>
<td></td>
</tr>
<tr>
<td>5. How many servings of red meat, ham, luncheon, or meat products (bacon, sausage, etc.) do you consume per day? (1 serving = 100-250g)</td>
<td></td>
</tr>
<tr>
<td>6. How many servings of rice, margarine or cream to your consumption per day? (1 serving = 1 medium sized serving)</td>
<td></td>
</tr>
<tr>
<td>7. How many coffee or tea beverages do you drink per day?</td>
<td></td>
</tr>
<tr>
<td>8. How much wine do you drink per week? (1 serving = 125mL)</td>
<td></td>
</tr>
<tr>
<td>9. How many servings of legumes do you consume per week? (1 serving = 75g)</td>
<td></td>
</tr>
<tr>
<td>10. How many servings of fish or shellfish do you consume per week? (1 serving = 100-250g or 4-5 small or 200g shellfish)</td>
<td></td>
</tr>
<tr>
<td>11. How many times per week do you consume commercial cheese or pastry (not homemade), such as cakes, cookies, biscuits?</td>
<td></td>
</tr>
<tr>
<td>12. How many servings of fruit (including praises) do you consume per week? (1 serving = 195g)</td>
<td></td>
</tr>
<tr>
<td>13. Do you preferly consume chicken, turkey or rabbit meat instead of beef, pork, ham, bacon, sausage or any other meat?</td>
<td>Y / N</td>
</tr>
<tr>
<td>14. How many times per year do you consume vegetables, pastas, rice or other dishes associated with olive oil and EVOO (extra virgin olive oil)</td>
<td></td>
</tr>
</tbody>
</table>


Low-fat diet Questionnaire

For Low-fat group only

<table>
<thead>
<tr>
<th>Foods and frequency of consumption</th>
<th>Y / N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How much olive oil do you consume in a given day (including all used for frying, salads, non-dairy sauces, etc)? (please answer to intervals: 0 (almost never) – approximately 25 mL)</td>
<td></td>
</tr>
<tr>
<td>2. Do you use olive oil for the list of chicken, duck, pork, lamb or beef meals before cooking and the list of soups, broths and cooked meat dishes before consumption (please circle Y or N)</td>
<td></td>
</tr>
<tr>
<td>3. How many servings of fish, chicken, ham, luncheon, or meat products (bacon, sausage, etc.) do you consume per week? (1 serving = 100-250g)</td>
<td></td>
</tr>
<tr>
<td>4. How many servings of rice, margarine or cream to your consumption per week? (1 serving = 1 medium sized serving)</td>
<td></td>
</tr>
<tr>
<td>5. Do you exclusively consume low-fat dairy products? (please circle Y or N)</td>
<td>Y / N</td>
</tr>
<tr>
<td>6. How many times per week do you prepare rice, pasta, potatoes or rice dishes by using &quot;flour&quot; (the principal ingredient except for beers) (such as flour, rice, etc. or fifty mix such as park or lasagne)?</td>
<td></td>
</tr>
<tr>
<td>7. How many times per week do you consume fatty fish or fish or seafood consumed in oil?</td>
<td></td>
</tr>
<tr>
<td>8. How many servings of commercial greens or industrial products (not homemade), such as salad, crackers, biscuits or cookies do you consume per week? (1 serving = 60g)</td>
<td></td>
</tr>
<tr>
<td>9. How many times per week do you consume meat (including praises), potatoes, rice, fish, or chicken or any other meat?</td>
<td></td>
</tr>
</tbody>
</table>

Score: / 9

Results – Baseline characteristics of groups

TABLE 1

Demographic and clinical characteristics of the study sample at baseline, according to first dietary intervention

<table>
<thead>
<tr>
<th>Group 1 (n = 20)</th>
<th>Group 2 (n = 21)</th>
<th>Total (n = 41)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>60.8 ± 6.3</td>
<td>59.6 ± 7.6</td>
</tr>
<tr>
<td>Gender, n</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Men</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education, y</td>
<td>15.6 ± 2.9</td>
<td>13.0 ± 2.7</td>
</tr>
<tr>
<td>Home SBP average, mm Hg</td>
<td>130.2 ± 11.4</td>
<td>126.1 ± 15.9</td>
</tr>
<tr>
<td>Home DBP average, mm Hg</td>
<td>78.1 ± 11.4</td>
<td>72.2 ± 12.9</td>
</tr>
<tr>
<td>Home HR average, mm Hg</td>
<td>71.7 ± 13.3</td>
<td>70.8 ± 25.8</td>
</tr>
<tr>
<td>Clinic SBP, mm Hg</td>
<td>139.8 ± 16.0</td>
<td>131.6 ± 12.9</td>
</tr>
<tr>
<td>Clinic DBP, mm Hg</td>
<td>86.6 ± 12.0</td>
<td>88.9 ± 10.0</td>
</tr>
<tr>
<td>Clinic HR, bpm</td>
<td>68.2 ± 10.6</td>
<td>68.0 ± 9.1</td>
</tr>
<tr>
<td>Insulin, mU/L</td>
<td>14.5 ± 7.5</td>
<td>11.6 ± 6.4</td>
</tr>
<tr>
<td>Glucose, mmol/L</td>
<td>5.9 ± 0.6</td>
<td>5.4 ± 0.5</td>
</tr>
<tr>
<td>Total triglycerides, mmol/L</td>
<td>1.7 ± 1.2</td>
<td>1.4 ± 0.5</td>
</tr>
<tr>
<td>Total cholesterol, mmol/L</td>
<td>5.9 ± 1.1</td>
<td>5.5 ± 0.9</td>
</tr>
<tr>
<td>HDL cholesterol, mmol/L</td>
<td>1.5 ± 0.4</td>
<td>1.5 ± 0.4</td>
</tr>
<tr>
<td>LDL cholesterol, mmol/L</td>
<td>3.7 ± 1.0</td>
<td>3.5 ± 0.9</td>
</tr>
<tr>
<td>Cholesterol/HDL cholesterol</td>
<td>4.4 ± 1.6</td>
<td>4.8 ± 1.0</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>87.7 ± 16.8</td>
<td>86.2 ± 12.1</td>
</tr>
<tr>
<td>Height, m</td>
<td>1.7 ± 0.1</td>
<td>1.7 ± 0.1</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>30.7 ± 4.0</td>
<td>30.9 ± 3.7</td>
</tr>
</tbody>
</table>

1Values are means ± SDs. Group 1 received the MedDairy intervention first; group 2 received the LF intervention first. *Different between groups, P < 0.05. bpm, beats per minute; CRP, C-reactive protein; DBP, diastolic blood pressure; HR, heart rate; LF, low-fat; MedDairy, Mediterranean diet with 3-4 daily servings of dairy foods; SBP, systolic blood pressure.

### Energy and macronutrient intake (Mean±SEM)

<table>
<thead>
<tr>
<th></th>
<th>MedDairy Wk 0</th>
<th>MedDairy Wk 8</th>
<th>LowFat Wk 0</th>
<th>LowFat Wk 8</th>
<th>Diet*Visit</th>
<th>Mean difference in 8 wk change (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (MJ)</td>
<td>9.5±0.3</td>
<td>8.9±0.3</td>
<td>9.3±0.3</td>
<td>8.1±0.3</td>
<td>0.01</td>
<td>0.8 (0.2, 1.4)</td>
</tr>
<tr>
<td>%enCHO</td>
<td>38±1</td>
<td>34±1</td>
<td>38±1</td>
<td>42±1</td>
<td>&lt;0.001</td>
<td>-8.5 (-11.5, -5.3)</td>
</tr>
<tr>
<td>%enPTN</td>
<td>18±1</td>
<td>20±1</td>
<td>19±1</td>
<td>21±1</td>
<td>0.3</td>
<td>-0.8 (-2.4, 0.7)</td>
</tr>
<tr>
<td>%enFat</td>
<td>35±1</td>
<td>37±1</td>
<td>35±1</td>
<td>27±1</td>
<td>&lt;0.001</td>
<td>9.6 (6.6, 12.6)</td>
</tr>
<tr>
<td>%enSFA</td>
<td>12±0.7</td>
<td>12±0.7</td>
<td>13±0.7</td>
<td>10±0.7</td>
<td>&lt;0.01</td>
<td>2.6 (0.8, 4.4)</td>
</tr>
<tr>
<td>%enPUFA</td>
<td>5.9±0.3</td>
<td>6.0±0.4</td>
<td>5.4±0.3</td>
<td>4.9±0.4</td>
<td>0.01</td>
<td>1.1 (0.2, 2.0)</td>
</tr>
<tr>
<td>%enMUFA</td>
<td>14±0.6</td>
<td>17±0.7</td>
<td>14±0.6</td>
<td>10±0.7</td>
<td>&lt;0.001</td>
<td>6.7 (4.9, 8.4)</td>
</tr>
<tr>
<td>MUFA:SFA</td>
<td>1.3±0.1</td>
<td>1.6±0.1</td>
<td>1.2±0.1</td>
<td>1.1±0.1</td>
<td>&lt;0.001</td>
<td>0.5 (0.3, 0.7)</td>
</tr>
<tr>
<td>%enAlcohol</td>
<td>5.4±0.9</td>
<td>4.6±0.9</td>
<td>4.6±0.9</td>
<td>5.2±0.9</td>
<td>0.48</td>
<td>-0.6 (-2.1, 1.1)</td>
</tr>
</tbody>
</table>

Mean±SEM; Weighed food record data.

### Results – Dietary Compliance (Mean±SEM)

Dietary compliance measured fortnightly using 14-point MedDiet adherence tool and 9-point LowFat adherence score (adapted from Estruch et al. 2013)
Results – Average MedDairy compliance (%)

Dietary compliance to MedDairy diet measured using daily checklist

Dairy food and calcium intake

- **Dairy foods***
  - Baseline vs Week 8: Serves per day
  - Difference at Week 8: \( p < 0.001 \)

- **Calcium intake**
  - Baseline vs Week 8: mg/day
  - RDI
  - NRV Calcium:
    - Women <50 and men <70: 1000mg
    - Women ≥50 and men ≥70: 1300mg

*sum of milk, yoghurt, cheese; Weighed food record data.*
Distribution of daily serves of dairy foods at week 8

<table>
<thead>
<tr>
<th>Serves of dairy food per day</th>
<th>Frequency</th>
<th>% of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2.9</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>25.7</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>37.1</td>
</tr>
<tr>
<td>3.5</td>
<td>7</td>
<td>20.0</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>11.4</td>
</tr>
<tr>
<td>4.5+</td>
<td>1</td>
<td>2.9</td>
</tr>
</tbody>
</table>

n=35; weighed food record data.

Dairy consumption (serves/day)

<table>
<thead>
<tr>
<th></th>
<th>MedDairy Wk 0</th>
<th>MedDairy Wk 8</th>
<th>LowFat Wk 0</th>
<th>LowFat Wk 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total dairy foods</td>
<td>*1.0 (0.6, 1.4) P&lt;0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td></td>
<td>*0.4 (0.2, 0.6) P&lt;0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td></td>
<td></td>
<td>*0.6 (0.4, 0.8) P&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Yoghurt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

n=35; weighed food record data;
*mean difference in 8 week change, (95% CI), diet*visit.
Results: Blood pressure

**Home (morning) SBP**

Baseline: 120 mmHg
Week 8: 118.4 mmHg
Mean difference: -1.6 mmHg
p-value: 0.01

**Clinic SBP**

Baseline: 130 mmHg
Week 8: 126.5 mmHg
Mean difference: -3.5 mmHg
p-value: 0.02

**Home (morning) DBP**

Baseline: 75 mmHg
Week 8: 74 mmHg
Mean difference: -1.0 mmHg
p-value: 0.01

**Home (afternoon) HR**

Baseline: 68 bpm
Week 8: 67 bpm
Mean difference: -1.3 bpm
p-value: <0.01

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Wade et al. (2018) *Am J Clin Nutr*

Results: Lipids & Lipoproteins

**Triglycerides**

Baseline: 1.1 mmol/L
Week 8: 1.05 mmol/L
Mean difference: -0.05 mmol/L
p-value: <0.01

**HDL**

Baseline: 1.5 mmol/L
Week 8: 1.46 mmol/L
Mean difference: -0.04 mmol/L
p-value: <0.01

**Cholesterol:HDL**

Baseline: 4.6
Week 0: 4.6
Week 8: 4.5
Mean difference: -0.1 mmol/L
p-value: <0.001

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Wade et al. (2018) *Am J Clin Nutr*
Comment – MedDiet, BP and lipids

MedDiet, BP & lipids¹,²

PREDIMED³, 1yr n=235 (85% HTN), 24h ABPM
- MedDiet+EVOO: 4.0 and 1.9mmHg,
- MedDiet+nuts: 4.3 and 1.9mmHg lower SBP and DBP than low fat diet group

PREDIMED⁴, 4yr follow-up n=7447
- MedDiet+EVOO: -1.53mmHg
- MedDiet+nuts: -0.65mmHg lower DBP than low fat diet group

SUN⁵ n=9408
Spanish MedDiet related to small reductions in BP 6yr after follow-up; suggesting adherence to a MedDiet could help attenuate/reduce age-related changes in BP

MedLey⁶
n=137, significant reduction in SBP compared with HabDiet group, 6 mo

EPIC-Florence⁷ n=13,597, 35-64yr
Italian MDS negatively correlated with SBP and DBP


Comment - MedDiet, dairy and BP

Dairy and risk of HTN (mod-high quality evidence) of association between total dairy, low-fat dairy, milk and lower risk of HTN¹

PREDIMED n=1868
20-28% RR of MetS (low fat dairy, yoghurt, milk)²

Framingham n=2636
Total dairy, low fat dairy, milk & yoghurt, attenuated rise in SBP and lower risk of projected HTN³

Conclusion

A Mediterranean diet with 3 daily serves of dairy:
• Feasible to follow for 8 weeks (92% adherence)
• Meets calcium requirements of Australians
• Improves blood pressure, heart rate and lipid profiles

Provided further information that supports the consumption of a MedDiet for health:
• In different population groups (at-risk population)
• Feasible in a non-Mediterranean population

Practice Tips – MedDiet is both diet AND lifestyle

1. Use EVOO as main culinary fat – dress salad, vegetables, pasta, you can cook with it
2. Have vegetables and salad at every main meal – frozen, fresh, canned ok
3. Choose 3-4 serves of dairy foods daily- mix of low fat and regular fat, go for Greek yoghurt and flavor with honey, spices or nuts
4. Swap meat for legumes twice a week – canned or dried ok
5. Fish and seafood twice a week – oily is preferable, canned or fresh is ok
6. Have red meat less often and choose white meat over red meat
7. Choose wholegrain or sourdough breads
8. 2 pieces of fresh fruit daily – canned in juice, frozen or dried is ok
9. 30g unsalted nuts daily
10. Moderate consumption of alcohol – choose red wine, no more than 2 standard drinks a day, enjoy with meals and friends
11. Be mindful of portion size
12. Eat until you are ¾ full
13. Be active instead of sedentary
14. Be mindful of stress, rest and relax, sleep well
Thank you.

**Acknowledgements:**
Mediterranean Dietary Patterns Team
Dietitian Connection

This project was funded by Dairy Australia Ltd.

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**Summary**

Little is known the relationship between the Mediterranean Dietary Pattern and muscle and bone health in children, adolescents and adults.

The Mediterranean Dietary Pattern may be adapted so that it meets Australian calcium recommendations and still leads to significant improvements in cardiovascular health.

https://www.google.com.au/search?q=image+of+mixed+almonds+walnuts+hazelnuts&tbm=isch&source=iu&ictx=1&fir=7lY9Kn5UCa-l9M%253A%252CdilLqkr2sAw0jEM%252C___&usg=Al4_-kTTslfGita9HLkCmem4CTWQSBeGKw&sa=X&ved=2ahUKEwjE7YGm383eAhWOb3oKHU9BBdMQ9QEwBXoECAYQDg#imgrc=fUb8Z3jMjfh1FM:

edgell.com.au/our-range/beans-salads