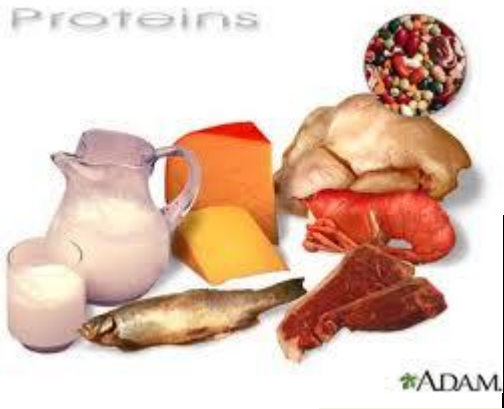
Dietary Strategies for improving muscle health in older Women



Topics:

- Older population
- Ageing and muscle mass
- Dietary protein requirements
- WHAM Study (Women's Healthy Ageing and Muscle Study)
  - Evaluation of health benefits & potential health risks ↑ dietary protein in older women
- Recommendations for practice

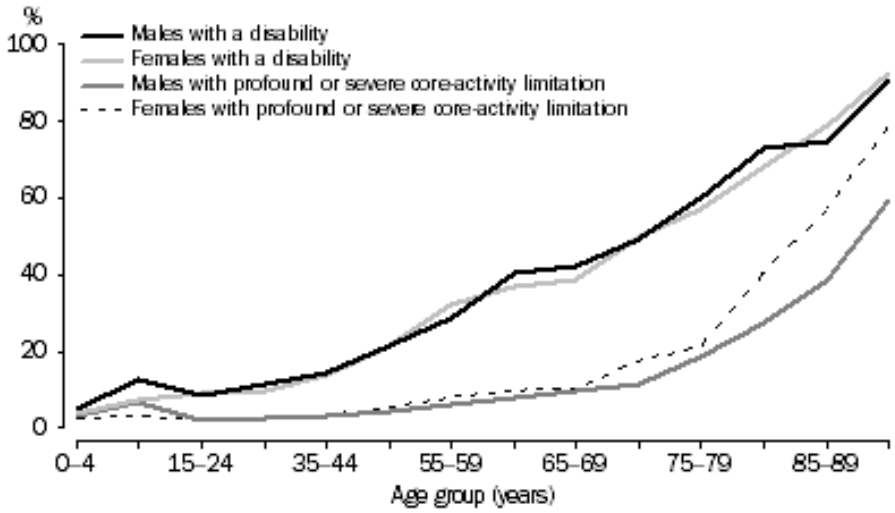
Australia 205

- 33 million people
- Almost 1 in 2 Australians > 50 years
- 9 million aged > 65 years:
  - > 1 in 4 Australians > 65 years
  - > 85 years 8% population
- Centenarians: growth> 20 times the rate of the total population by 2050
- What is middle age/old age ?
- Doctors willing to aggressively treat people once considered too old

100-year-old runner finishes Toronto marathon
90 Year Old Marathon Runner Gets Caught!

Disability increases with age

- One in five Australian disability
- Disability rate ↑age
  - severe core-activity limitation
    - 10% for 65-69 years
    - 74% > 90 years



- Females > 80 years ↑ severe limitation core-activity
- Females: 52%
- Males : 34%

http://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/4430.0?OpenDocument

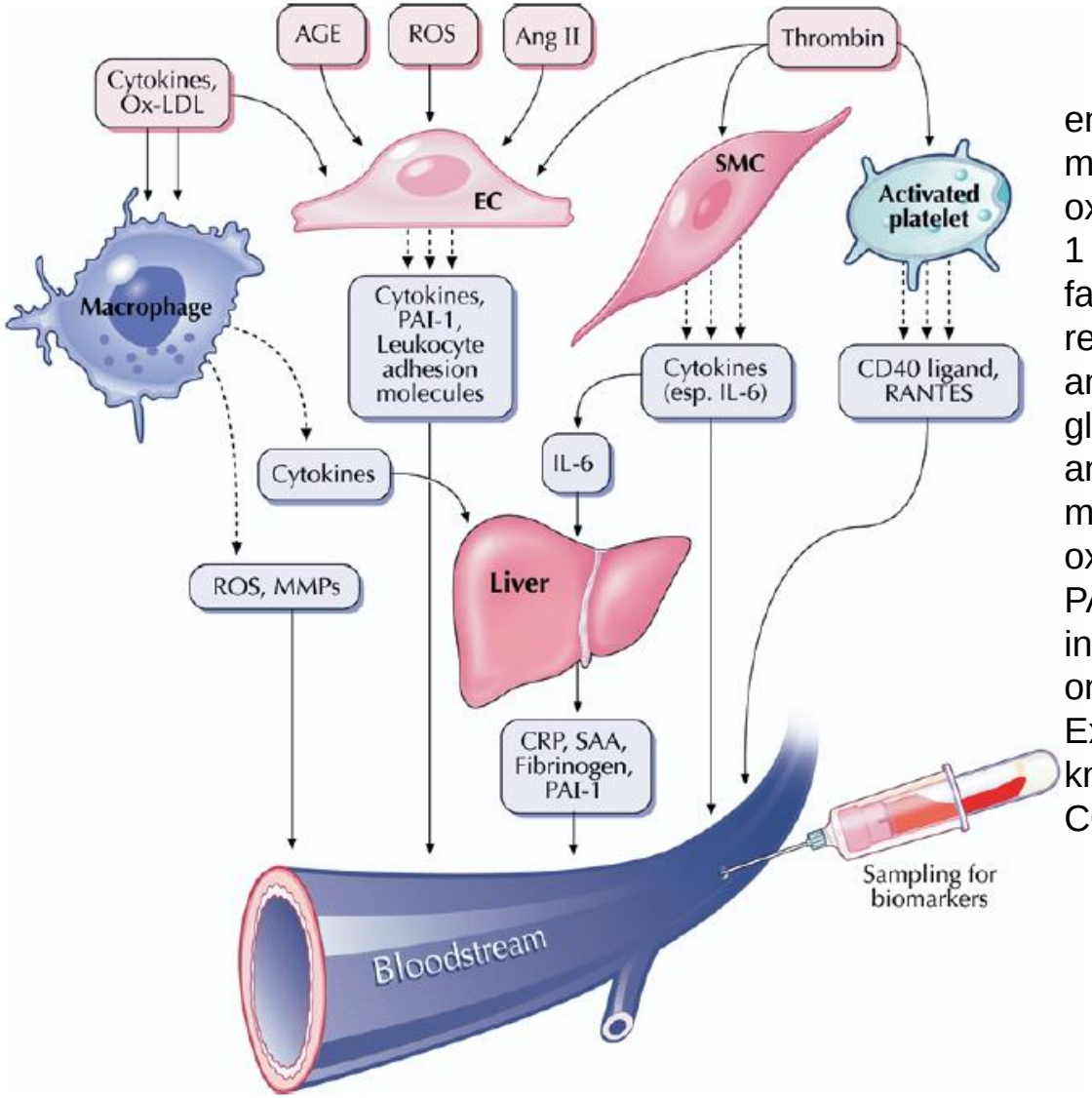
Centenarians: fastest-growing age segment

- > 340,000 worldwide
  - Highest numbers US & Japan
- 6M 100-year-olds by 2050 worldwide
- What does it means to be old/middle-age
- Centenarians: growth> 20 times the rate of the total population by 2050
- Doctors willing to aggressively treat the health problems of people once considered too old for such care

100-year-old runner finishes Toronto marathon
90 Year Old Marathon Runner Gets Caught!

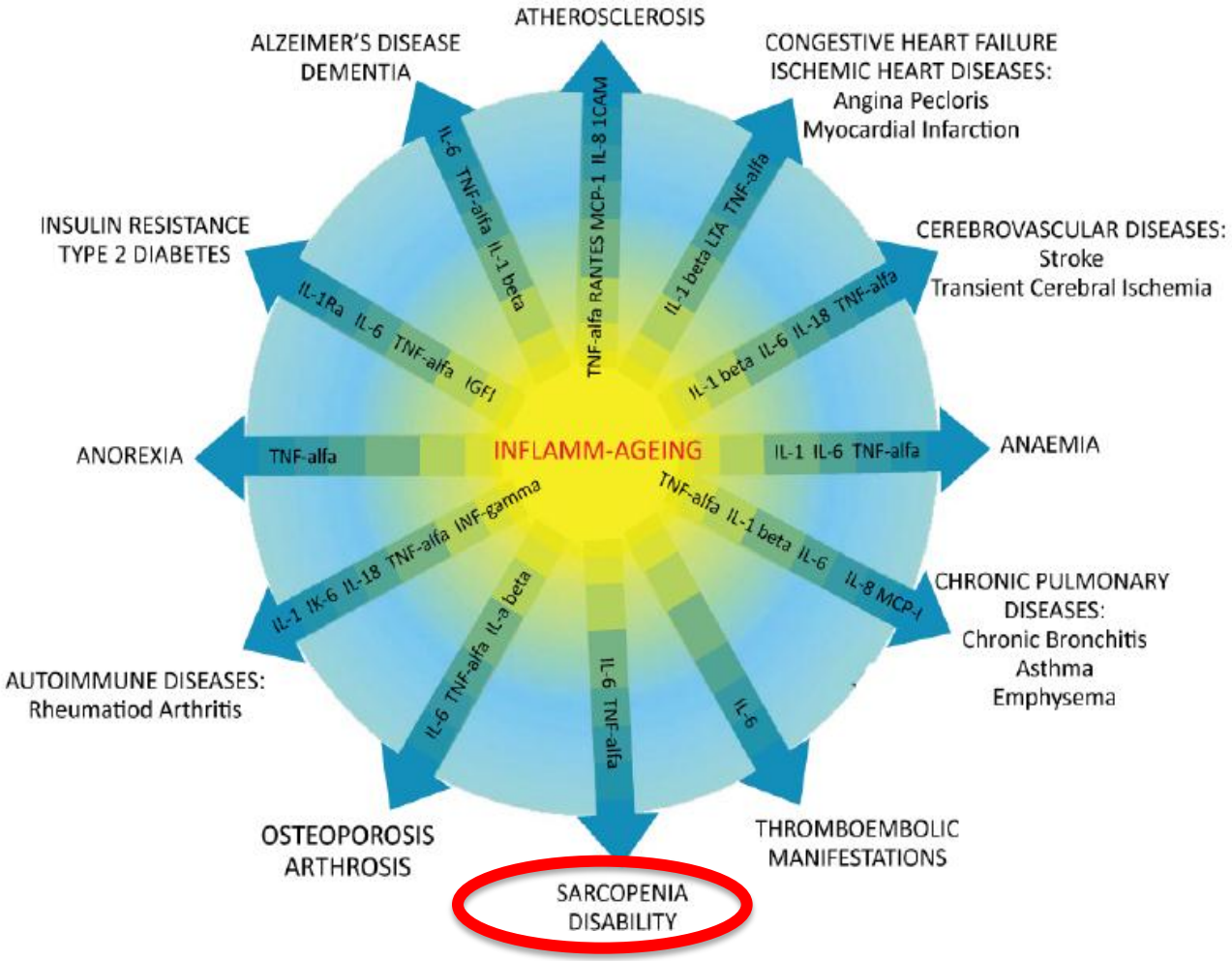
“Inflamm-ageing”

Figure 6.3 Inflammatory pathway linked risk factors



endothelial cells (EC), smooth muscle cells (SMC), reactive oxygen species (ROS), interleukin-1 (IL-1), tumour necrosis factor-alpha, interleukin-6 IL-6 , C-reactive protein (CRP), serum amyloid A (SAA), AGE _advanced glycation end products; Ang II _ angiotensin II; MMPs _ matrix metalloproteinases, OxLDL _ oxidized low-density lipoprotein; PAI-1 _ plasminogen activator inhibitor-1; RANTES _ Regulated on Activation, Normal T Cell Expressed and Secreted (also known as chemokine ligand 5, CCL5)

Figure 6.2 **Inflammatory networks in ageing, age-related diseases and longevity – inflamm-ageing 2**



(De Martini, Franceschi Monti & Ginaldi, 2006

Changes in Body Composition

- Age-related decrease in Muscle Mass
- By 50 yrs average person lost 10% muscle mass + corresponding ↓ strength
- By 70 yrs loss ↑ 40%
- Chronic muscle loss affect 30% those > 60 y & affect 50% > 80 y

Paddon-Jones D, Short KR, Campbell WW, Volpi E, Wolfe RR. Role of dietary protein in the sarcopenia of aging. Am J Clin Nutr. 2008 May;87(5):1562S-1566S

Adverse consequences of decreased muscle mass in older people.

- loss of aerobic capacity
- loss of strength
- loss of balance
- increased likelihood of falls
- loss of independence, which all contribute to functional impairment

Emerging Evidence: optimal health higher protein

- protein intake > 0.8g/kg can improve :
  - muscle mass,
  - strength and function
  - immune status
  - wound healing
  - bone health

Wolfe RR, Miller SL, Miller KB. Optimal protein intake in the elderly.

Clin Nutr. 2008 Oct;27(5):675-84.

Aust. & NZ Protein Requirement Older adults

- Protein intake ↓ decrease with age)
  - ↓ appetite
  - ↑satiety
  - dentition/chewing difficulties
  - Social isolation
  - Financial constraints
  -
- ↓ protein synthetic efficiency
  - impaired insulin action
  - ↓ gastric emptying
  - ↓ splanchnic uptake
  - ↓ Utilisation: peripheral tissues

- Aust. Protein RDA ~20% higher >70y

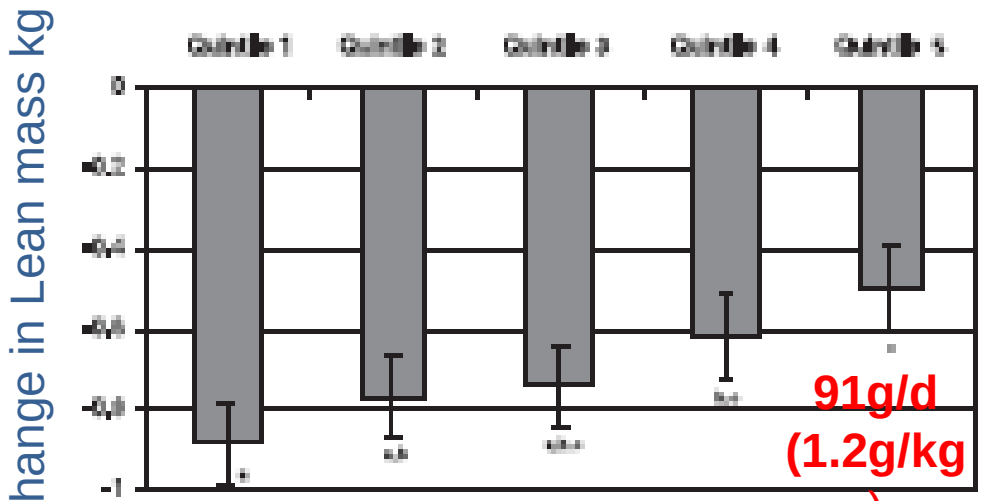
Adults	EAR	RDI
Men		
19–30 yr	52 g/day (0.68 g/kg)	64 g/day (0.84 g/kg)
31–50 yr	52 g/day (0.68 g/kg)	64 g/day (0.84 g/kg)
51–70 yr	52 g/day (0.68 g/kg)	64 g/day (0.84 g/kg)
>70 yr	65 g/day (0.86 g/kg)	81g/day (1.07 g/kg)
Women		
19–30 yr	37 g/day (0.60 g/kg)	46 g/day (0.75 g/kg)
31–50 yr	37 g/day (0.60 g/kg)	46 g/day (0.75 g/kg)
51–70 yr	37 g/day (0.60 g/kg)	46 g/day (0.75 g/kg)
>70 yr	46 g/day (0.75 g/kg)	57 g/day (0.94 g/kg)

NH&MRC NRVs 2006

ABC longitudinal Study: 3yr >2000, 70-79 year olds

- Highest quintile protein intake (91g/day(1.2g/kg) 40% less loss in lean body mass cf lowest quintile(57g/d (0.8g/kg))

- Animal, but not vegetable, protein was significantly associated with preservation of lean body mass



Energy Adjust. Lean mass by quintiles

57g/d
(0.8g/kg)

Housten et al. Am J Clin Nutr 2008;87:150 –5

Emerging Evidence: optimal health higher protein

- N-balance studies do not measure any relevant physiological end point
- Supplement: essential aa (~30g protein x2/d)
  - ↑ lean body mass, strength, functional test scores in healthy elderly subjects without any alteration in normal dietary intake or exercise
- beneficial effect protein may be mediated by stimulation of insulin-like growth factor 1 (IGF-1)
- IGF-1 levels lower in older people
- 1.5 g protein/kg/day, reasonable target for elderly wishing to optimize protein intake in terms of health and function

Wolfe RR, Miller SL, Miller KB. Optimal protein intake in the elderly. Clin Nutr. 2008 Oct;27(5):675-84. Boersheim E, Bui QU, Tissier S, Kobayshi H, Ferrando AA, Wolfe RR. Amino acid supplementation improves muscle mass, strength and physical function in elderly. Clin Nutr April 2008;27(2):189e95.

Background

- Protein intake falls with age
- Evidence ↑ protein requirements older people
- Evidence ↑ protein requirements with RT

- Red Meat major source of protein in the Australian diet
  - high biological value:
- ↓ meat intake ↑ age
  - Australian adults > 60 years consuming 34% less meat compared to those aged 25-44 years {McLennan, 1999 }

Rationale

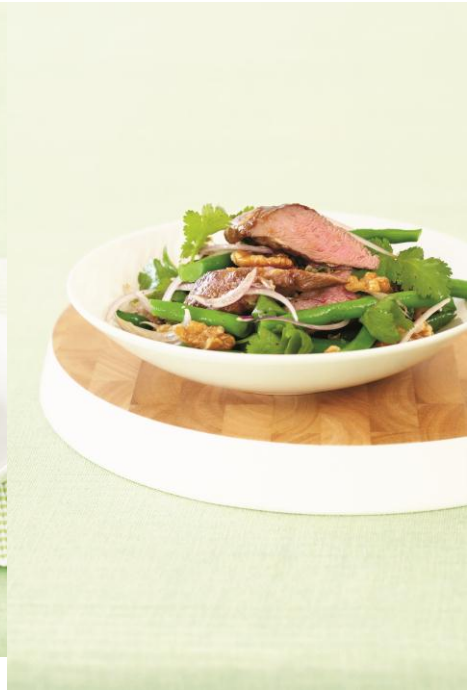
- Evidence resistance training (RT), enhance muscle-protein synthesis, muscle mass and strength, in older people

- Not known if increased consumption of protein in combination with regular exercise (resistance training) can lower inflammation and enhance muscle mass and function in the elderly

Lucas M, Heiss CJ. Protein needs of older adults engaged in resistance training:. J Aging Phys Act. 2005 Apr;13(2):223-36

? Risks of increasing dietary protein in older people

- Adverse impact on dietary intake: other nutrients
- Diet high in red meat intake may increase systemic inflammation
  - ? saturated fat intake.
  - ? ↑ dietary iron
- Increase cardiovascular risk factors
  - serum cholesterol
  - HDL cholesterol
  - Glucose , insulin
- Reduced kidney function-
  - Exacerbate poor renal function



Women's Healthy Ageing and Muscle Study

Effects of Resistance Training Combined with Red Meat on Musculoskeletal and Cardiometabolic Health

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This study was funded by a grant from Meat and Livestock Australia

Study Aim and Hypothesis

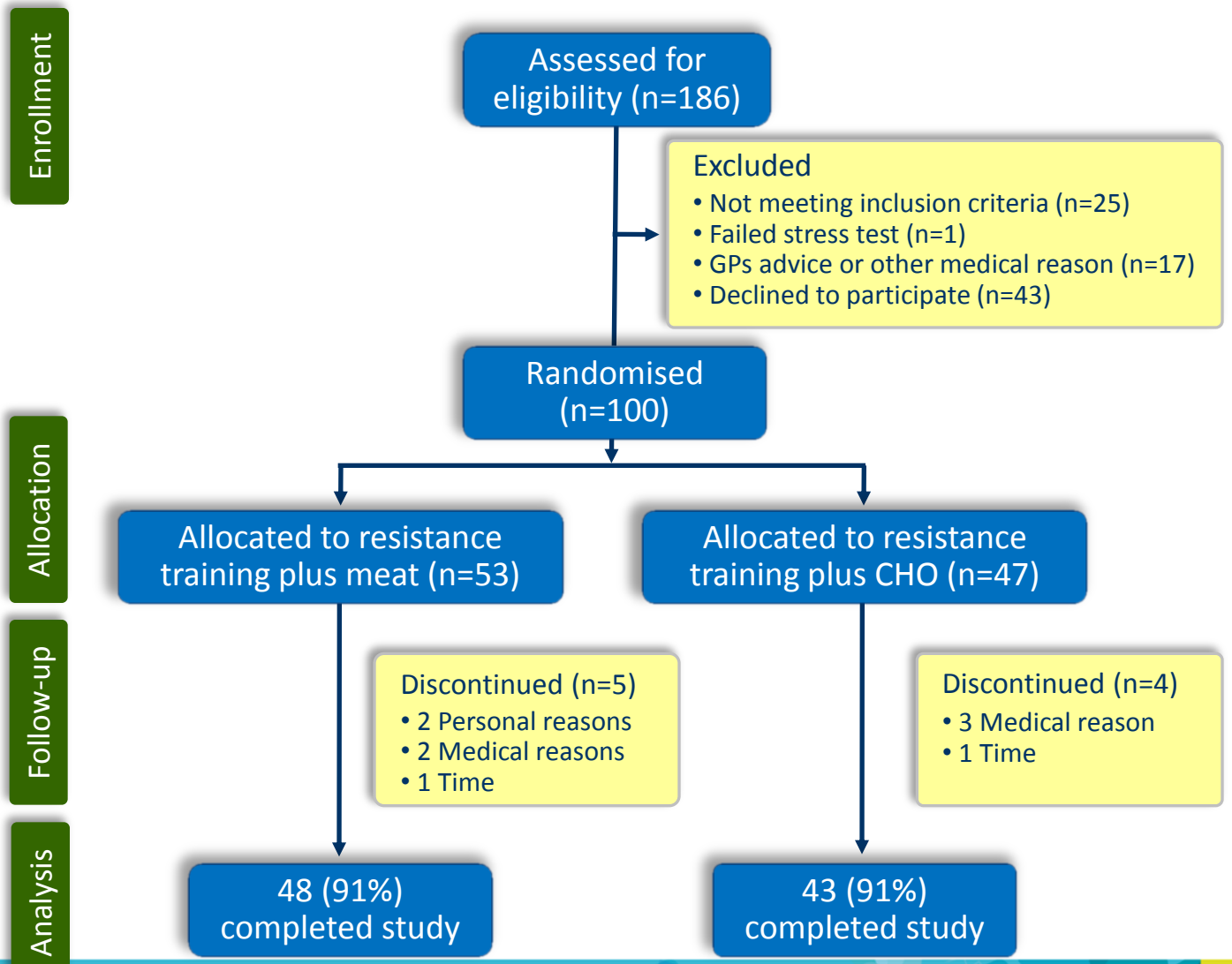
Study Aim

- To investigate whether increasing dietary protein compared to a control carbohydrate intervention , enhances muscle mass, strength and function in older women, when combined with resistance training, in a vitamin D replete state

Study Hypothesis

- Increasing the intake of dietary protein to at least 1.3 g/kg/d, through an increased intake of lean red meat, combined with Progressive Resistant Training (PRT) will lead to greater gains in muscle mass, strength and function compared to PRT plus carbohydrate (Control) over 14 weeks

Study Flow Chart



Exercise Program

Program

- Weights on Wheel van visited each village twice a week for 4 months to deliver the program
- 32 exercise sessions in total.
- Exercise sessions run by qualified exercise trainers
- Small group sessions (6-8 women per group); 45 to 60 minutes per session

Mode

- *Type*: Progressive resistance training
- *Dose*: 3 sets of 8-12 reps
- *Intensity*: 15-16 (hard-very hard) on RPE Scale
- Dumbbells, ankle weights, Swiss balls
- Sessions conducted prior to lunch / dinner if possible

Intervention

Lean Red Meat Group

- ≈220 g (raw weight) of lean red meat (~160 g cooked)/day for 6 days per week (protein intake ≈1.3 g/kg/d)
- Mixed variety of lean red meat (beef, lamb, veal)
- Consume the meat across two meals: lunch / dinner (~80 g per meal)
- Received individual counseling sessions and written dietary instructions, including recipes, on consuming the lean red meat.

Intervention

Carbohydrate (Control) Group

- Make small changes to the amount (portion sizes) of protein rich foods consumed at meal times and to eat more pasta, rice, breads and cereals.
- Participants were provided with packs of pasta and rice every 2-4 weeks, and advised to consume at least one serve 1/2 cup of cooked rice or pasta, or potato daily.

All women in both groups provided with vitamin D_3 supplements (1000 IU/d)

Baseline Characteristics ±(SD)

Characteristic	Meat	Control: CHO	P-value
N	53 (48 complete)	47 (43 complete)	
Age, years	72.1 ± 6.4	73.6 ± 7.7	0.75
Weight, kg	70.0 ± 11.3	68.4 ± 11.5	0.15
BMI, kg/m^2	27.7 ± 3.9	27.6 ± 4.8	0.2
Walking, hours per week	5.2 ± 3.7	5.0 ± 3.0	0.82
Physical activity, hours per week	9.6 ± 6.1	7.9 ± 4.3	0.1
Anti-hypertensive therapy, n (%)	31 (58%)	27 (57%)	0.92
Lipid lowering therapy, n (%)	16 (30%)	18 (40%)	0.31
Protein Intake g	74.5 ± 23.7	73.4 ± 26.9	0.56

Whole group Protein 1.11 ± 0.39 g/kg/d

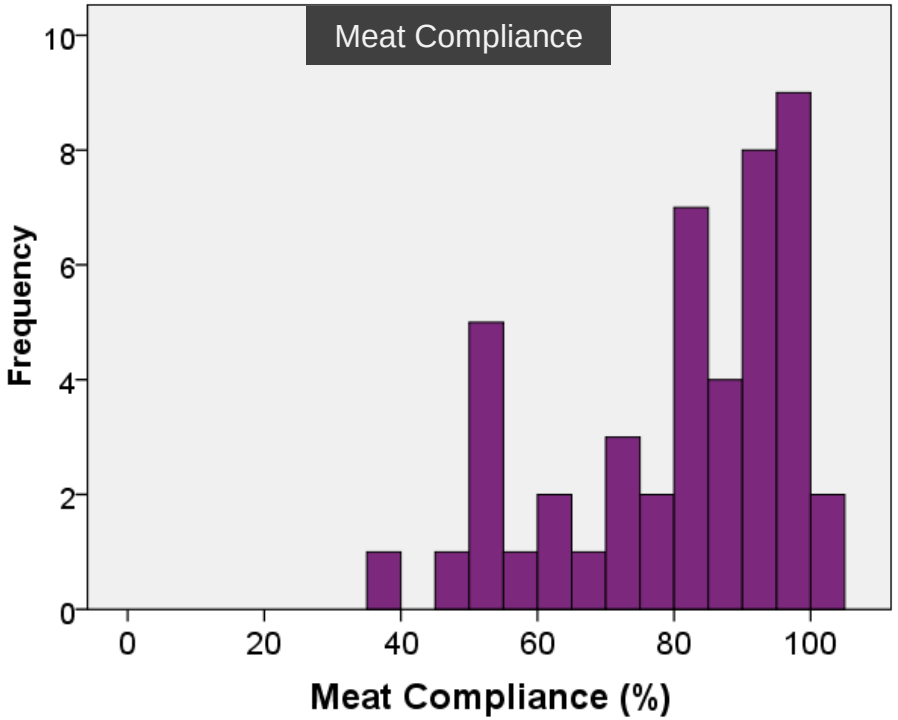
Compliance with the Program

Dietary Intervention

- Lean red meat 80%
  (2 serves per day ≈160 g cooked)
- Carbohydrate 100%
  (1/2 cup per day of pasta, rice, potato)

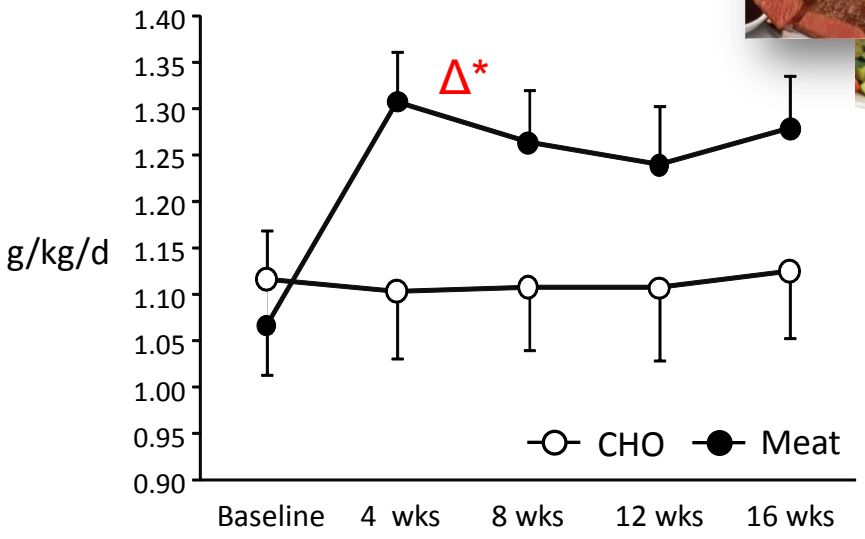
Vitamin D supplementation

- Lean red meat 92%
- Carbohydrate 93%

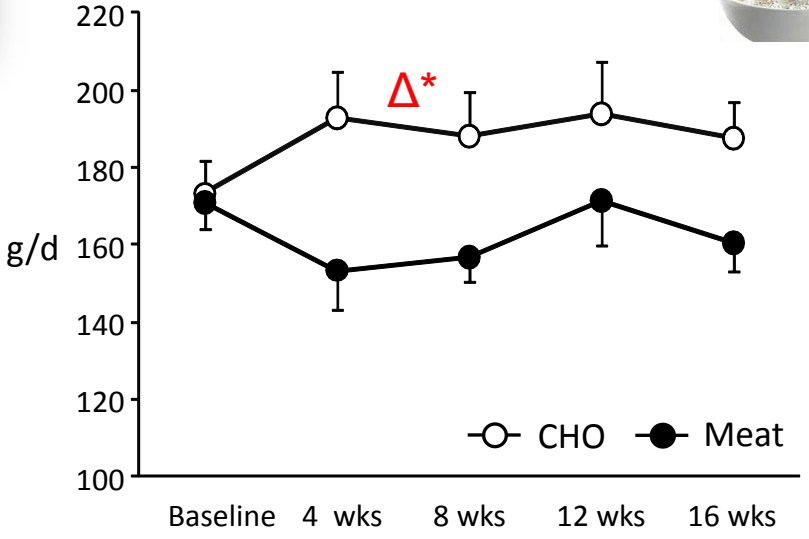


Dietary Intake

Meat Group*
1.3 ± 0.3 g/kg/d



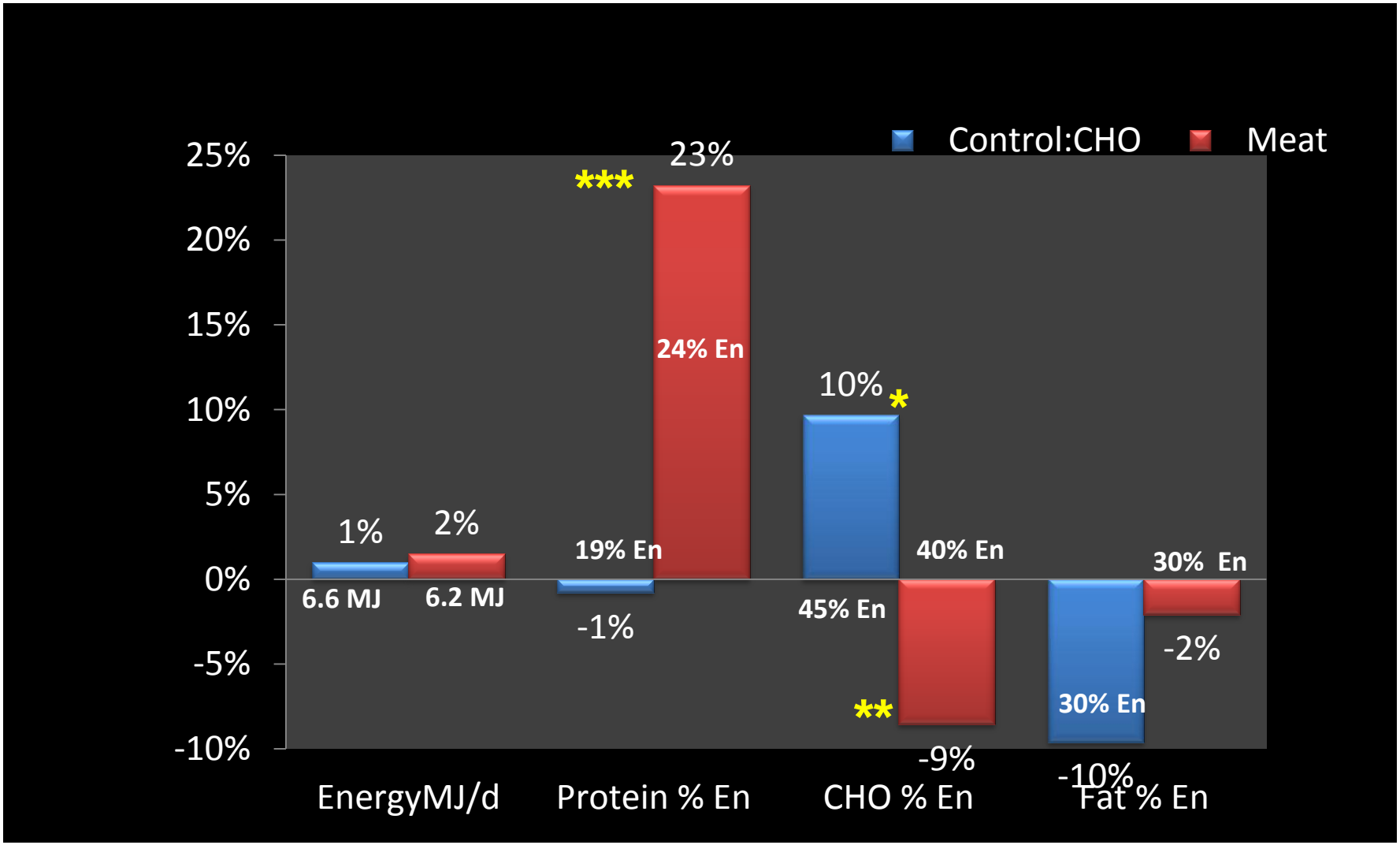
CHO control Group*
1.1 ± 0.4 g/kg/d



*Between group P<0.05

Δ* baseline v intervention P<0.05

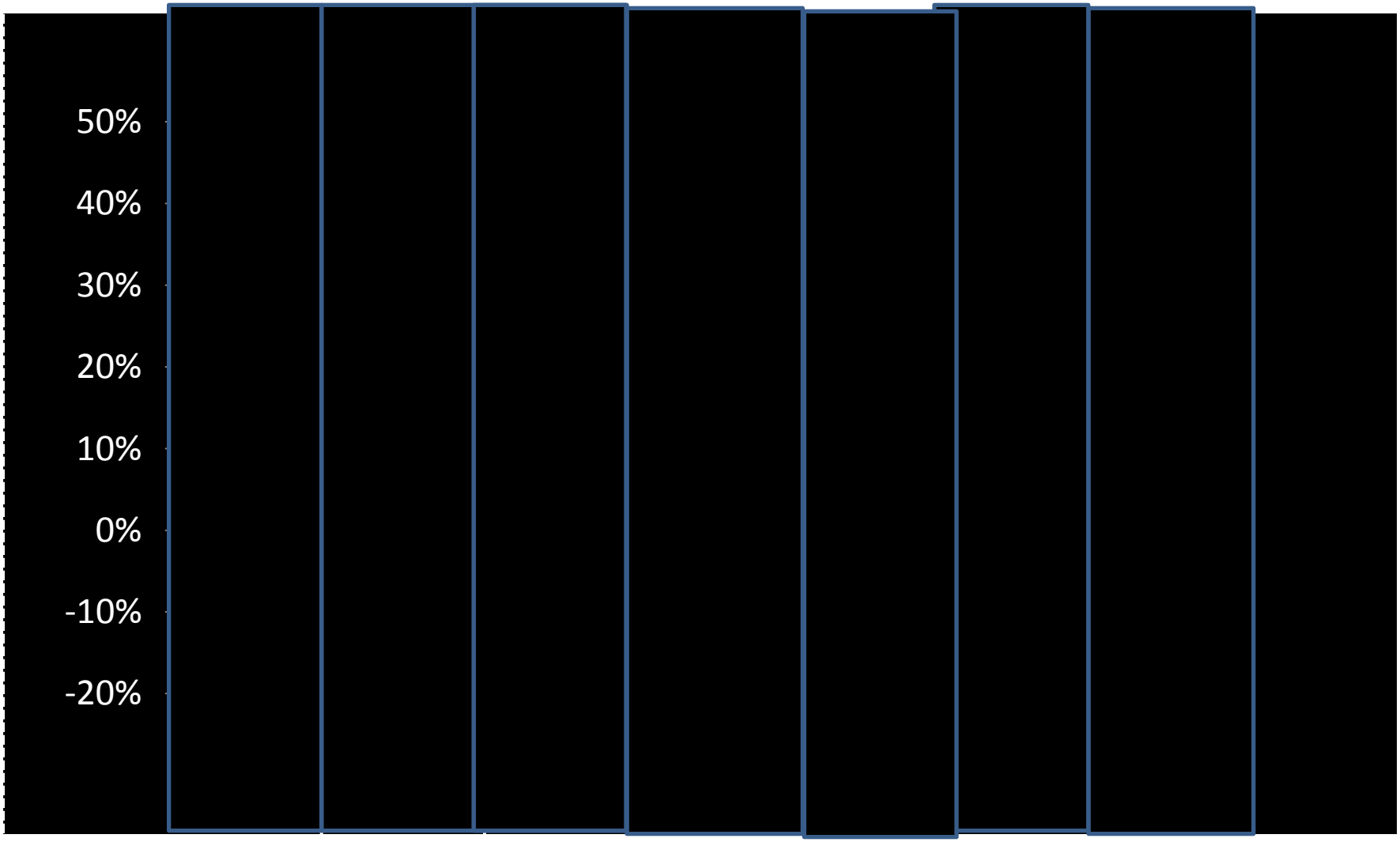
% Change (baseline v intervention)
Energy & % Energy Macronutrients



Baseline 24hr recall v Intervention (4x 24hr recalls, monthly)

*** P<0.001, **P<0.01, * P<0.05

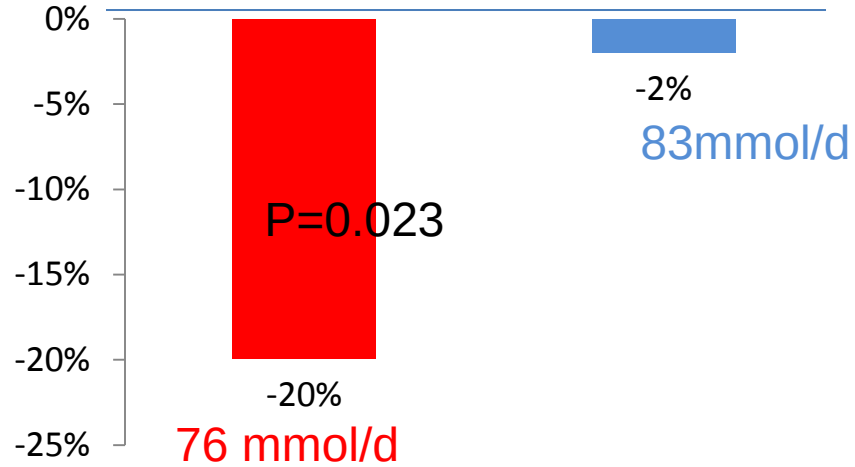
% Change (baseline v intervention)
Average Daily Nutrient Intakes



*** P<0.001, **P<0.01, * P<0.05

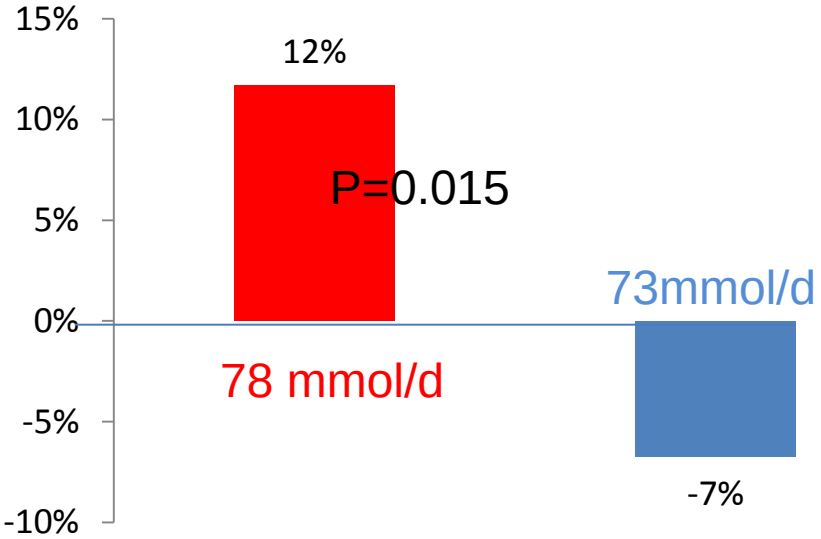
Baseline 24hr recall v Intervention (4x 24hr recalls, monthly)

Dietary Sodium/Potassium % change



Sodium mmol/d

Meat
Control:CHO



Potatssium mmol/d

CVD risk factors

	Meat	± SD (95% CI)	Control CHO
Body Weight			
Baseline, kg	70.0 ± 11.4		68.4 ± 11.6
Absolute Δ 4 mo	0.05 (-0.33, 0.43)		-0.17 (-0.55, 0.22)
Total Cholesterol			
Baseline, mmol/L	5.46 ± 1.22		5.56 ± 1.02
% change	**-6%****		**-4%****
HDL-cholesterol			
Baseline, mmol/L	1.49 ± 0.32		1.60 ± 0.34
% change	**-1%**		**-1%**
LDL-cholesterol			
Baseline, mmol/L	3.39 ± 1.01		3.36 ± 0.96
% change	**6%***		**6%***
Triglycerides			
Baseline, mmol/L	1.41 ± 1.00		1.32 ± 0.57
% change	**-10%**		**-1%**
Glucose			
Baseline, mmol/L	5.7 ± 1.0		5.6 ± 1.0
% change	**-47%**		**-69%**

Baseline values are means ± SD; within and between-group differences are means with 95% CI. All between-group differences adjusted for use of lipid-lowering medication (cholesterol and lipids). * P<0.05, ** P<0.01 † P<0.001 within-group change relative to baseline; # P<0.05 between-group difference for the change relative to baseline (group-by-time interaction).

Protein status: Kidney function

Serum	Meat ± SD (95% CI)	Control:CHO	Between-Grp Differ. (95% CI)
Urea			
Baseline, mmol/L	5.9 ± 1.3	6.2 ± 1.6	
% Δ 4 mo	8.9 (2.5, 15.2) **	3.5 (-2.8, 9.8)	5.4 (-3.5, 14.2)
% change	**2%****	**1%**	
Creatinine			
Baseline, umol/L	68.8 ± 10.8	70.2 ± 10.0	
% Δ 4 mo	-2.0 (-7.3, 3.4)	-0.7 (-3.0, 1.6)	-1.2 (-7.2, 4.7)
% change	**-3%**	**-1%**	
eGFR			
Baseline, mL/min/1.73m^2	77.2 ± 10.8	76.1 ± 10.9	
% Δ 4 mo	0.9 (-3.0, 4.7)	0.4 (-2.0, 2.7)	0.5 (-4.0, 5.1)
% change	**1%**	**1%**	
Albumin			
Baseline, g/L	43.3 ± 3.3	44.5 ± 2.9	
% Δ 4 mo	-0.0 (-3.7, 3.7)	-2.3 (-4.0, -0.6) **	2.3 (-1.9, 6.4)
% change	**0**	**-2%****	

- Excluded those with renal impairment (eGFR <45 ml/min)

Normal kidney function= eGFR, ≥60 ml/min/1.73m^2; Mild = mildly decreased eGFR, 45 to 59 ml/min/1.73m^2

No Adverse effects: Kidney function

- Excluded those with renal impairment (eGFR <45 ml/min)

Kidney Function	Meat	Control CHO
Normal to Normal eGFR		
4 months	45 (93.8%)	38 (88.4%)
Normal to Mild eGFR		
4 months	**1 (2.1%)**	**0 (0.0%)**
Mild to Normal eGFR		
4 months	1 (2.1%)	1 (2.3%)
Mild to Mild eGFR		
4 months	1 (2.1%)	4 (9.3%)

eGFR = ml/min/1,73m^2

Normal kidney function= eGFR, ≥60 ml/min/1.73m^2; Mild = mildly decreased eGFR, 45 to 59 ml/min/1.73m^2

24-hour urinary excretion

	Meat ± SD	CHO	Between-Group Differences (95% CI)
Urea			
Base mmol/24 h	378 ± 118	376 ± 134	
% Δ 2 mo	**13.4% †**	**-0.9%**	**14.2 (3.0, 25.4) #**
% Δ 4 mo	2.4%	-1.1%	3.5 (-8.6, 15.6)
Sodium			
Base mmol/24 h	128.8 ± 56.1	125.7 ± 54.5	
Salt equiv. g/d	7.5	7.4	
% Δ 4 mo	**1.1%**	**8.9%**	-7.8 (-26.4, 10.7)
Potassium,			
Base mmol/24 h	68.4 ± 21.1	67.4 ± 22.9	
% Δ 4 mo	**5.8%**	**3.0%**	2.9 (-8.4, 14.1)
Creatinine, Base mmol/24 h			
Baseline	7.8 ± 1.8	7.7 ± 1.7	
% change	**4.5**	**-2.2**	6.7 (-3.3, 16.7)

Baseline values are means ± SD; within and between-group differences are unadjusted means with 95% CI. † P<0.001 P<0.05, ** P<0.01 † P<0.001 within-group change relative to baseline; # P<0.05 between-group difference for the change relative to baseline (group-by-time interaction).

Vitamins and Inflammatory markers

	Meat	Control CHO	Between-Group Diff. (95% CI)
25-OHD Base, nmol/L	68.4 ± 26.8	70.0 ± 31.6	
Absolute Δ 4 mo	10.4 (4.1, 16.7) †	13.1 (7.3, 19.0) †	-2.8 (-11.3, 5.8)
Vit B12 Baseline, pmol/L	338 ± 127	299 ± 125	
% Δ 4 mo	2%	-3%	4.8 (-1.9, 11.5)
IGF-1 Base, nmol/L	15.4 ± 5.6	15.3 ± 6.2	
% Δ 4 mo	**+9%†**	-2%	**10.2 (3.1, 17.3) #**
IL-6 Base, pg/mL	23.3 ± 88.1	20.6 ± 89.0	
% Δ 4 mo	**-16%***	-1%	**-15.7 (-43.5, 12.1) #**
IL-10 Base, pg/mL	37.3 ± 94.0	51.3 ± 261.8	
% Δ 4 mo	-15%	-10%	-4.8 (-32.1, 22.5)
TNF-α Base, pg/mL	6.9 ± 3.4	7.8 ± 3.3	
% Δ 4 mo	**-9%***	**-6%**	-1.4 (-13.3, 10.5)

Baseline values are means ± SD; within and between-group differences are unadjusted means with 95% CI. * P<0.05 within-group change relative to baseline; # P<0.05 between-group difference for the change relative to baseline (group-by-time interaction).

Mean baseline blood pressure by group and the within-group changes

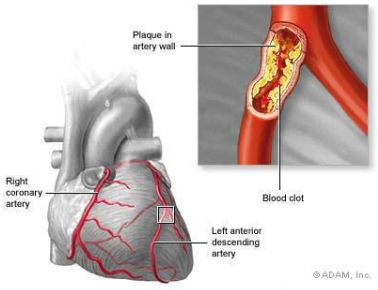
Characteristics	Meat	Control CHO	Between-Group Differences (95% CI)
Systolic			
Baseline, mmHg	137.0 ± 15.8	134.9 ± 14.7	
Absolute Δ 4 mo	-7.1 (-11.5, -2.8)†	-3.4 (-8.5, 1.7)	-3.7 (-10.3, 2.8)
Diastolic, mmHg			
Baseline	75.2 ± 9.3	74.3 ± 8.4	
Absolute Δ 4 mo	-3.9 (-6.4, -1.4) **	-0.4 (-0.4, 3.4)	-3.5 (-7.9, 0.9)

All between-group differences adjusted for use of anti-hypertensive medication (blood pressure). * P<0.05, ** P<0.01 † P<0.001 within-group change relative to baseline; # P<0.05 between-group difference for the change relative to baseline (group-by-time interaction).

Key Findings 1

- daily consumption of ~160g of cooked lean red meat well tolerated high compliance (81%)
- Increased dietary protein from 1.1g/kg to 1.3g/kg (~74g/d - 89g/d)
- Dietary Changes : Meat Group
- 23% increase protein
- 9% decrease % En CHO
- 12% increase iron
- 44% increase zinc
- 12% reduction calcium
- 20% reduction sodium
- 17% increase potassium
- No change in body weight
- No reduction ↓ serum albumin (CHO (control) ↓ 2%)

Key Findings (2)



- Protein intake ≥1.3 g/kg/d with red meat, when combined with twice-weekly progressive resistance training (RT):

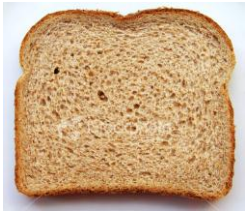
- Meat group: greater ↑ IGF-1 (7 to 10%) cf to CHO control
- Meat group: greater ↓ pro-inflammatory marker IL-6 (16%) cf to CHO control
- Meat group : ↓ pro-inflammatory marker TNF-α (9%)
- No adverse effects of increasing protein intake on:
- kidney function
- cholesterol or lipoprotein levels : beneficial effects
  - total cholesterol ↓ ~0.24 mmol/L, LDL-cholesterol ↓~ 0.20 mmo
- Blood pressure: beneficial effects
  - Meat group: ↓ 7/4mmHg (signf)
  - CHO control group: ↓ -3/-0.4 mmHg (non signif)

Dietary Pattern A Baseline

6 .1MJ
49g Protein
14% En Protein

Breakfast:
Orange Juice
Sweet Biscuit (2)

Lunch:
1 slice mixed grain bread
Butter
Vegemite



Dinner
Canned Mushroom Soup 480ml
Cake 1 slice
Jam

Mid meals:
Dates
Nuts
Sugar 1 tsp
Milk 250ml
Coffee

Dietary Pattern A Intervention: Meat

6 .7MJ

98g Protein (49g)

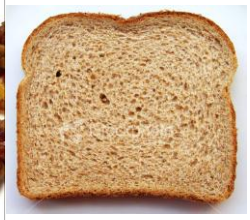
25% En Protein (14%)

Breakfast:

Orange Juice
Oats
Honey
Sultana
Nut
0.5 tbl
sustagen (1g prot)

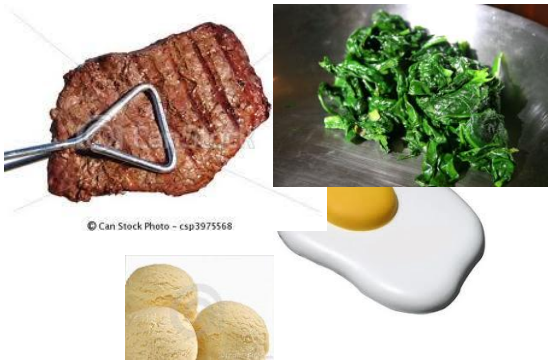
Lunch:

Beef strips 85g
Stock, tomato paste, onion sauce
1 slice mixed grain bread
Butter
Brandy
1 glass ginger ale



Dinner

Beef , sirloin steak 85g
Spinach 1 cup
1 egg
Ice cream, 3 scoops
1 cone



Mid meals:

Sugar 2 tsp
2 Coffee /milk (1g prot/cup)

Dietary Pattern B Baseline

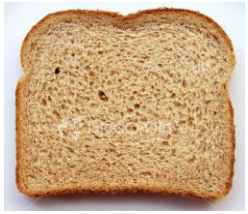
3.9MJ

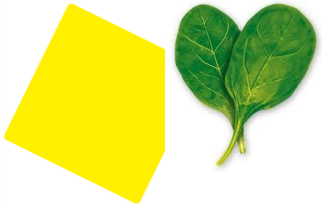
48g Protein

21% En Protein

Breakfast:
Oats
Sultana
Prune
Banana
½ cup milk

Lunch:
I slice mixed grain bread
1 slice cheese
Tomato
Spinach
Mandarin





Dinner
1 Lamb chump chop 80g
Carrot (1/4)
Sweet Potato (1 cup)
Potato baked 1
Spinach (15 leaves)
1 glass wine
1 orange

Mid meals:
Biscuits
Coffee

044base

Dietary Pattern B
Meat Intervention

6.6MJ
100g Protein (48g)
26% En Protein (21%)

Breakfast:
Lemon Juice
Oats
Sultana
Banana
½ cup milk

Lunch:
Beef stir fry strips 85g
Sauce
1 egg
Cereal ¼ cup
Avocado
Tomato
Coffee milk

Dinner
Beef stir fry strips 85g
Sauce
1 egg
Cereal ¼ cup
Silverbeet, carrot, sweet potato
Brussels sprouts
Stewed apple
Rhubarb
Yogurt
Mandarin
1 glass wine

Mid meals:
Coffee milk x2
1 tartlet

044wk4

Summary

- Emerging evidence that dietary protein requirements greater for older people
- Progressive Resistant Training to prevent muscle loss and reduce bone loss may require greater intakes protein
- Protein intake ~1.3g/kg in older women (~73yrs) achievable and no adverse effects (renal, cardiovascular)
- Positive effect on muscle and inflammatory markers

Older people (>70yrs): Health & Quality of Life

UK RDA

Protein 0.8g/kg

Australia: RDI

Protein 0.94 - 1.07g/kg

? Protein 1.3g/kg