

Weight Loss for Young Women - What Works?



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Research Team

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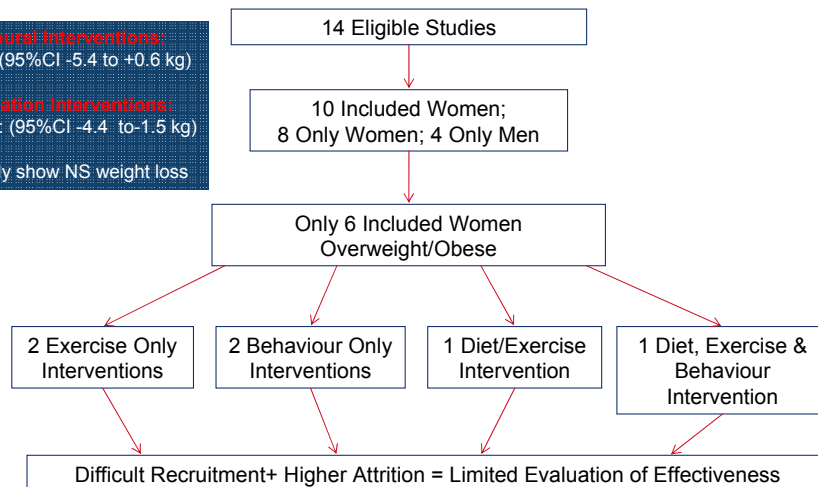
Systematic Review Weight Loss Interventions Participants 18-25 y

Poobalan et al 2010

Behavioural Interventions:
-2.4 kg; (95%CI -5.4 to +0.6 kg)

Combination Interventions:
-2.96 kg; (95%CI -4.4 to -1.5 kg)

Generally show NS weight loss



Study Aims

- Conduct weight management trial in young (18-25y) women
 - Include diet, exercise & behaviour modification
- Develop nutritionally sound restricted energy (5,600 kJ) meal plans
- Compare the effectiveness of two diets:
 - Higher carbohydrate (HC) (conventional)
 - Higher protein (HP) (novel)
- Monitor blood parameters (metabolic syndrome, iron status)
- Monitor eating behaviours & self worth

- **Weight & Body Composition Targets**
 - Minimum weight loss (> 5% initial weight)
 - Ideal (\geq 10% of initial weight)
 - Maintenance of lean mass (< 1 kg)
 - Waist loss (2-5 cm/y)

Study Hypotheses

Weight & Body Composition

- Clinically effective weight loss; not differential between groups
 - Mean > 5% initial weight in both groups
- Lean mass retained; losses predominantly fat
- Waist circumference loss significantly greater in HP diet

Metabolic Parameters

- Similar between groups; greater reduction [insulin] HP group
- Iron and zinc status better maintained on HP diet

Eating Behaviours & Self Worth

- Improved (not differential between groups)
- Significantly lower hunger in HP group
- Both diets 'acceptable' to participants

Outcome Measures

Primary

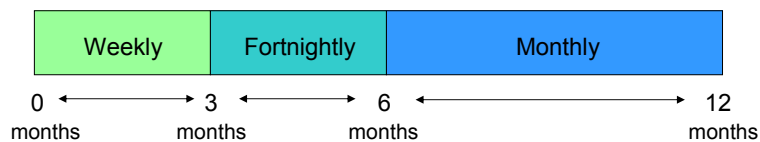
- **Weight loss & Body Composition (Baseline, 6 & 12 months)**
 - Absolute (kg) and relative loss (% initial weight)
 - Change in absolute & relative fat and lean mass (DXA)
 - Change in waist circumference (cm)

Secondary

- **Eating Behaviours & Self Worth (Baseline, 3, 6 & 12 months)**
 - Restraint, disinhibition & hunger (Eating Inventory) + VAS
 - Binge Eating (Gormally)
 - Self Worth (Harter)
- **Metabolic Parameters (Baseline, 6 & 12 months)**
 - Lipids, glucose, insulin, inflammatory & immune markers

Study Design

- Randomized clinical trial (random block, single blind)
- Recruitment, treatment (0-6 months), follow-up (6-12 months)
- Face to Face: education, counseling and collection of data



- Bodylines behaviour program - lifestyle advice (0-3 months)



Participants

n=70 required (35 each arm)

Exclusion criteria

- Medical conditions (including OSA)
- Smoking
- Medications (appetite, metabolic rate)
- Immobility
- Previous bariatric surgery
- Severe eating disorder
- Pregnancy or breastfeeding
- Iron deficiency anaemia
- Use of dietary supplements

Inclusion criteria

- Healthy women
- 18-25 years
- BMI \geq 27.5 kg/m²
- Non vegetarian



Macronutrients Study Diets & Exercise

Nutrient	HP Diet	HC Diet
Energy (kJ)	5615	5602
Protein (g)	107 (32% of E)	67 (20% of E)
Carbohydrate (g)	138 (41% of E)	191 (58% of E)
Sugars (g)	73	83
GI/GL	46/61	52/93
Dietary fibre (g)	23	24
Total fat (g)	38 (25% of E)	32 (21% of E)
Saturated fat (g)	11	10
Cholesterol (mg)	298	87



30 min accumulated physical activity daily (activity diary)

Dietary Intake (3 day food diary)

Micronutrients - Study Diets

Nutrient	EAR/AI	HP Diet	HC Diet
Thiamin (mg)	0.9	1.6	1.8
Riboflavin (mg)	0.9	2.5	2.5
Niacin Equiv (mg)	11	47	32
Vitamin C (mg)	30	156	160
Total Folate (µg)	320	332	355
Vitamin A Equiv (µg)	500	1058	1307
Sodium (mg)	460-920	2186	1940
Potassium (mg)	2800	3554	3096
Magnesium (mg)	255	318	268
Calcium (mg)	840	908	877
Phosphorus (mg)	580	1725	1282
Iron (mg)	8.0	12.2	9.9
Zinc (mg)	6.5	11.7	7.6

Study Diets

Food Group	Units/day	1 unit exchange
Cereal	1	40 g high fibre low GI breakfast cereal
Bread	3	1 slice wholegrain bread
Rice and pasta	HP: 0 HC: 1.75	120 g cooked rice or pasta
Lean meat	HP: 3 (1 at lunch; 2 at dinner) HC: 1	HP: 100 g raw lean meat or 2 eggs HC: 80 g raw lean meat
Dairy	2	250 mL skim milk
Fruit	2	150 g fresh or canned
Vegetables	2.5	1 cup cooked or salad
Fats and oils	3	5 g canola/olive oil or margarine
Alcohol and treats	<i>2 units/week</i>	150 mL wine or 430 kJ treat

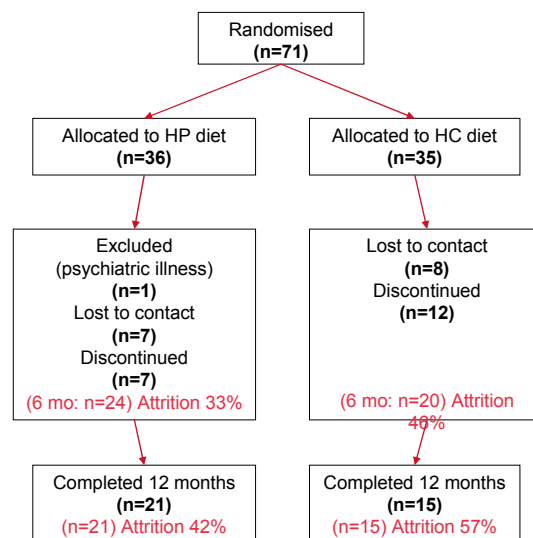
Sample Size

- $\alpha = 0.05$; Power 80%; mean difference 5 kg
- $n=28$; rounded to 30; recruit $n=35$ each arm (10-15% attrition rate)

Statistics

- SPSS Version (Version 17)
- Repeated ANOVA, ANCOVA, Chi-Square
- Intention to treat analysis (last weight carried forward)
- Completers analysis (6 & 12 months)
- Data: Mean \pm SEM

Randomisation & Attrition Flow Chart



Participant Characteristics

Parameter	HP	HC	P Value
Age (y)	22.4 ± 0.4	22.5 ± 0.4	0.82
Weight (kg)	95.2 ± 2.0	94.3 ± 2.5	0.78
BMI (kgm ⁻²)	34.1 ± 0.7	33.8 ± 0.8	0.75
Waist (cm)	95.7 ± 1.7	94.6 ± 1.8	0.63

Waist: International Diabetes Federation Guidelines.

Weight, Waist & Fat Loss (All Participants)

	All Participants		P Value	
	HP (n=36)	HC (n=35)	Diet	D*T
% Loss Initial Weight				
6 months	-6.5 ± 1.4	-4.3 ± 0.9	0.16	0.18
12 months	-7.0 ± 1.9	-3.8 ± 1.0		
Wt Loss (kg)				
6 months	-6.3 ± 1.3	-3.9 ± 0.8	0.34	0.15
12 months	-6.9 ± 1.8	-3.5 ± 0.9		
Δ BMI (kgm⁻²)				
6 months	-2.2 ± 0.5	-1.4 ± 0.3	0.78	0.13
12 months	-2.5 ± 0.7	-1.2 ± 0.3		
Δ Waist (cm)				
6 months	-5.5 ± 1.0	-2.7 ± 0.7	0.61	0.03
12 months	-7.8 ± 2.7	-2.4 ± 0.7		
Δ Lean Mass				
6 months	-0.6 ± 0.3	-0.4 ± 0.3	0.96	0.77
12 months	-0.6 ± 0.4	-0.3 ± 0.2		
Δ Fat Mass				
6 months	-5.5 ± 1.3	-2.1 ± 0.7	0.06	0.046
12 months	-5.9 ± 1.7	-2.2 ± 0.7		

Weight & Waist Loss (Completers)

	6 Month Completers		P Value		12 month Completers		P-Value	
	HP (n=24)	HC (n=20)	Diet	D*T	HP (n=21)	HC (n=15)	Diet	D*T
% Loss Initial Wt								
6 months	-9.3 ± 1.8	-5.1 ± 1.3	0.06	0.049	-8.8 ± 1.8	-5.6 ± 1.7	0.16	0.31
12 months					-9.8 ± 2.7	-4.6 ± 1.6		
Wt Loss (kg)								
6 months	-8.9 ± 1.7	-4.6 ± 1.2	0.03	0.06	-8.5 ± 1.6	-5.1 ± 1.3	0.07	0.22
12 months					-9.6 ± 2.6	-4.1 ± 1.4		
Δ BMI (kgm⁻²)								
6 months	-3.2 ± 0.6	-1.6 ± 0.4	0.31	0.06	-3.1 ± 0.6	-1.7 ± 0.5	0.32	0.14
12 months					-3.5 ± 0.9	-1.4 ± 0.5		
Δ Waist (cm)								
6 months	-7.8 ± 1.3	-3.7 ± 1.0	0.30	0.12	-7.5 ± 1.3	-3.2 ± 0.9	0.36	0.10
12 months					-7.9 ± 1.8	-2.4 ± 0.8		

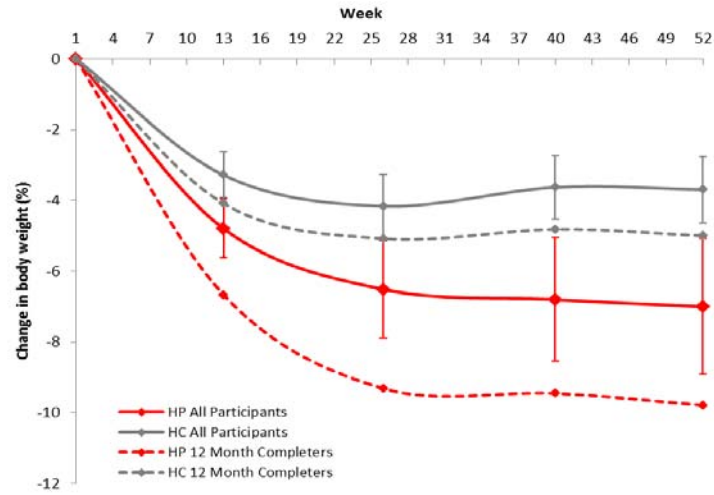
Fat Loss (Completers)

	6 Month Completers		P Value		12 month Completers		P-Value	
	HP (n=24)	HC (n=20)	Diet	D*T	HP (n=21)	HC (n=15)	Diet	D*T
Δ Lean Mass								
6 months	-0.9 ± 0.5	-0.7 ± 0.6	0.32	0.87	-1.0 ± 0.5	-0.5 ± 0.5	0.22	0.72
12 months					-0.9 ± 0.5	-0.3 ± 0.3		
Δ Fat Mass								
6 months	-8.0 ± 1.7	-3.4 ± 1.2	0.04	0.05	-7.5 ± 1.6	-4.0 ± 1.1	0.14	0.25
12 months					-8.3 ± 2.3	-4.2 ± 1.2		

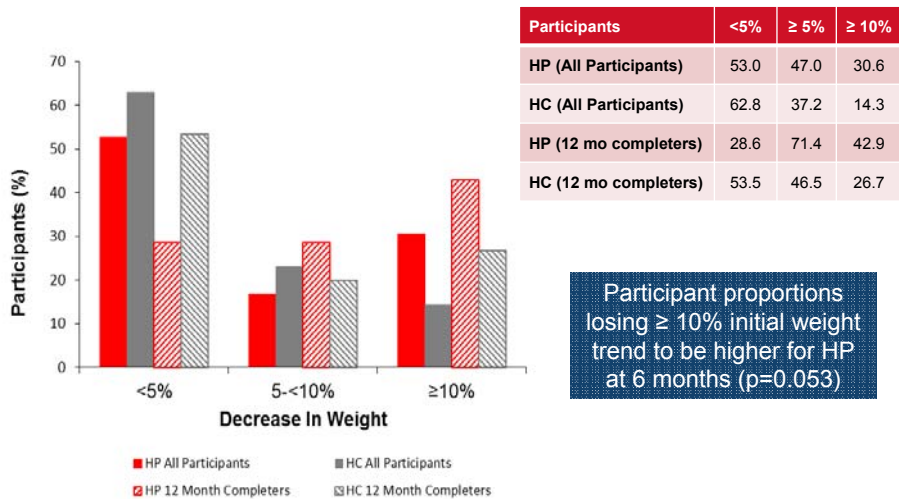
Weights of Participants Before Transfer into Maintenance Energy Intake

Diet	Weight (kg)	BMI kgm ⁻²
HP	63.7	21.7
HP	64.4	22.2
HC	73.1	23.3

Weight Loss



Participants Losing > 5 & 10% Initial Weight



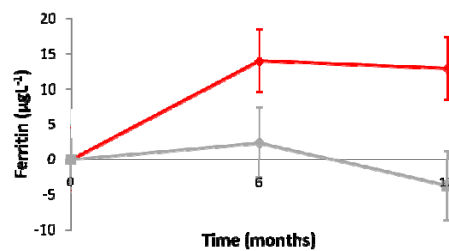
Participant proportions losing $\geq 10\%$ initial weight trend to be higher for HP at 6 months ($p=0.053$)

Dietary Intake (Completers)

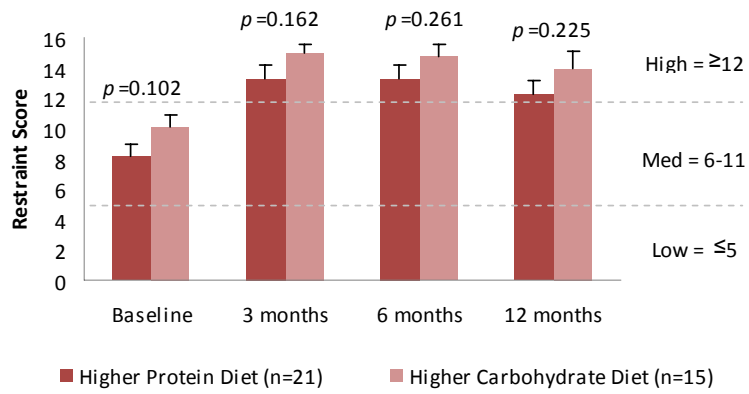
	Diet		P Value	
	HP (n=36)	HC (n=35)	Diet	D*T
Energy kJ.d⁻¹	5615	5602		
6 months	5865 ± 273	5073 ± 455	0.04	0.896
12 months	5786 ± 275	4638 ± 283	0.006	0.744
Protein (% of E)	32% of E	20% of E		
6 months	28.7 ± 0.9	20.6 ± 0.7	<0.001	0.0899
12 months	28.3 ± 1.2	22.5 ± 1.1	<0.001	0.562
Fat (% of E)	25% of E	21% of E		
6 months	26.8 ± 1.3	25.6 ± 1.3	0.196	0.307
12 months	28.3 ± 1.3	25.4 ± 2.2	0.043	0.701
Saturated Fat (% of E)	7% of E	6.6% of E		
6 months	9.7 ± 0.6	9.8 ± 0.8	0.213	0.481
12 months	9.9 ± 0.7	8.7 ± 2.9	0.027	0.608
Carbohydrate (% of E)	41% of E	58% of E		
6 months	44.6 ± 1.4	51.3 ± 1.3	< 0.001	0.208
12 months	42.5 ± 1.1	50.8 ± 2.5	<0.001	0.598
Fibre (gd⁻¹)	23 g	24 g		
6 months	22.0 ± 3.4	18.6 ± 1.4	0.472	0.373
12 months	18.7 ± 0.8	18.6 ± 1.8	0.683	0.698

Micronutrient Status - Iron

Ferritin (15-165µgL ⁻¹)	Diet		P Value	
	HP	HC	Diet	D*T
6 month completers				
Ferritin at 6 months (µgL ⁻¹)	52.8 ± 6.2	45.9 ± 7.4		
Δ 6 months	14.4 ± 4.8	-3.2 ± 5.1	0.007	N/A
12 month completers				
Ferritin at 6 months (µgL ⁻¹)	53.8 ± 6.6	44.1 ± 6.2		
Ferritin at 12 months (µgL ⁻¹)	52.7 ± 6.6	38.0 ± 5.4		
Δ 6 months	14.0 ± 4.4	2.4 ± 5.0	0.02	0.38
Δ 12 months	13.0 ± 4.6	-3.7 ± 4.9		

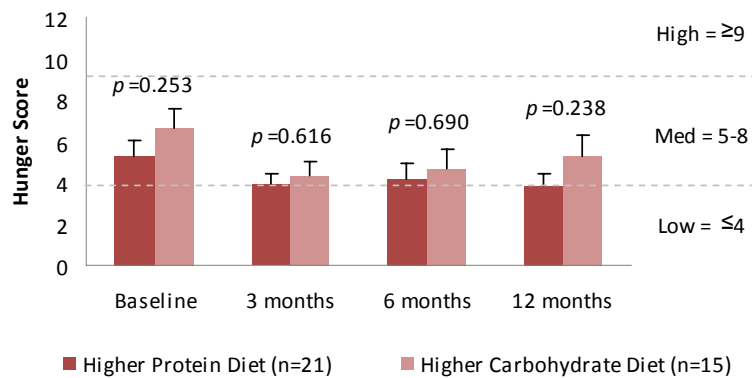


Eating Behaviours - Restraint



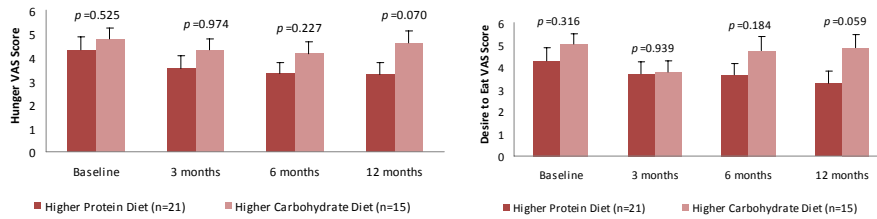
Repeated Measures ANOVA: Diet: 0.115; Diet*Time: 0.942; Time: <0.001

Eating Behaviours - Hunger



Repeated Measures ANOVA: Diet: 0.329; Diet*Time: 0.428; Time: 0.002

Hunger & Desire to Eat VAS

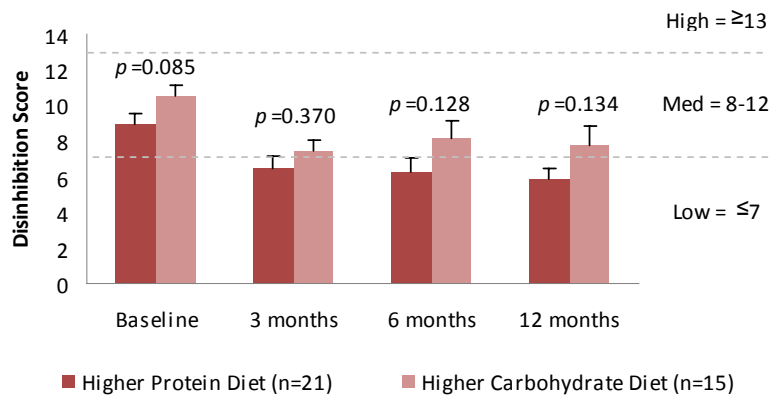


Repeated Measures ANOVA:
Diet: 0.184; Diet*Time: 0.229; Time: 0.459

Repeated Measures ANOVA:
Diet: 0.138; Diet*Time: 0.337; Time: 0.203

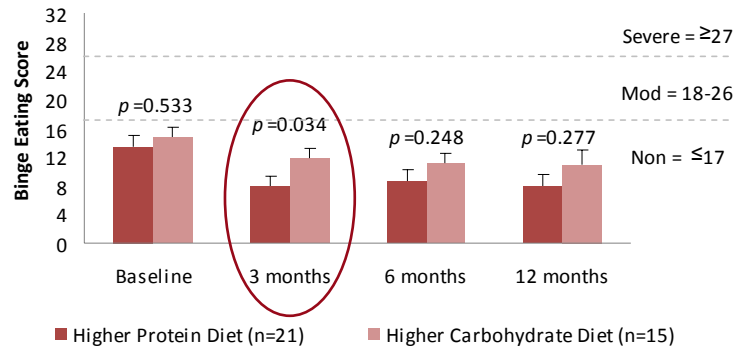
VAS: Hunger extremely hungry → not at all hungry
Desire extremely strong → not at all strong

Eating Behaviours – Disinhibition



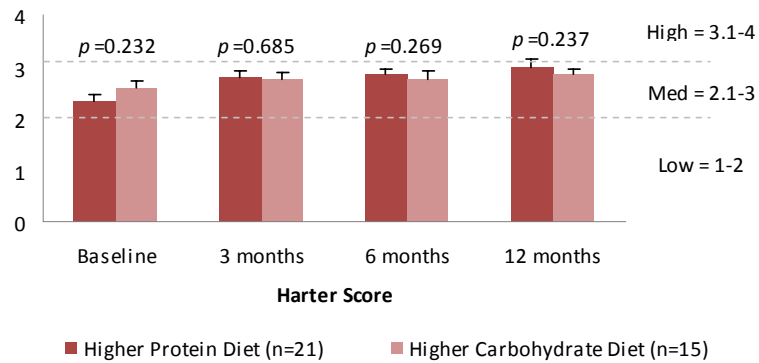
Repeated Measures ANOVA: Diet: 0.095; Diet*Time: 0.722; Time: <0.001

Eating Behaviours – Binge Eating



Repeated Measures ANOVA: Diet: 0.152; Diet*Time: 0.549; Time: <0.001

Self Worth



Repeated Measures ANOVA: Diet: 0.662; Diet*Time: 0.015; Time: <0.001

Discussion: Weight & Body Comp

All Participants

- Both groups had meaningful weight loss at 12 months
 - HP: 7% initial weight; 8 cm waist
 - HC: ~4% initial weight; 2 cm waist
 - > 5% loss: HP: 47%; HC: 37.2%
 - > 10% loss: HP: 30.6%; HC: 14.3%
- Greater rate of waist loss HP (P=0.03)
- Greater rate of fat loss HP (p=0.05)

Met NHMRC Guidelines
2-6 kg & 2-5 cm waist loss
over one year
DPP 5-7% Initial Wt (only
HP)

Discussion: Weight & Body Comp

Completers

- Greater weight loss at 6 months in HP (p=0.03)
- Greater fat loss at 6 months in HP (p=0.04)
- % loss initial weight sig trend for HP (Diet: 0.06; Diet*Time: 0.05)
- Losses NS different at 12 months
 - HP: ~ 10% initial weight; 8 cm waist
 - HC: ~ 5% initial weight; 2 cm waist
 - > 5% loss: HP: 71.4%; HC: 46.5%
 - > 10% loss: HP: 42.9%; HC: 26.7% (sig trend 6 mo HP P=0.053)
- 3 participants (2 HP; 1 HC) achieved goal weight ~6 months
 - Moved to maintenance energy to prevent further weight loss
- Lean mass retained (mean < 1 kg loss) in both groups

Met NHMRC Guidelines
2-6 kg & 2-5 cm waist loss
over one year
DPP 5-7% Initial Wt



Diet, Micronutrients & Energy Expenditure

Diet Intake (completers)

- Close to prescribed (supported by urea:creatinine ratio)
- Significant differences in protein & carbohydrate intake
- Reported energy intake lower in HC
 - Suspected under-reporting (higher disinhibition?)
- Iron was a limiting nutrient

Micronutrient Status (completers)

- Ferritin level better maintained HP red meat diet
- NS zinc status

Energy Expenditure (completers)

- NS difference in energy expenditure between groups ($p=0.67$; 0.74)
- Main weight loss effects diet related

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Eating Behaviours: Eating Inventory

Completers

- Changes as expected via behavioural intervention (sig effect time)
- In direction that supports weight management

Restraint

- Increased from medium to high (NS between groups)

Disinhibition

- Decreased medium to low HP (remained medium HC)
- NS between groups

Hunger (inc VAS)

- Decreased from medium to low (NS between groups)
- Decrease in hunger & desire to eat VAS (NS between groups)

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Completers

Binge Eating (Gormally)

- Decreased & remained in low range throughout
- Lower scores at 3 months in HP ($p=0.03$)
- NS at other time points & via repeated ANOVA
- Improvement supports weight management

Self Worth (Harter)

- Improved in both groups
- Remained in medium range throughout
- Greater rate of improvement in HP ($p=0.015$)

- **Recruitment of young women challenging**
- **Attrition higher than middle age cohorts**
 - Consistent with the literature
- **Losses in young women appear superior to middle age (HP)**
- **Both diets supported clinically effective weight loss in completers**
 - HP diet is as or more effective than HC approach
 - Weight regain was less evident 6-12 months (?behavioural component)
- **Differences in weight & fat loss:**
 - Appear due to diet not differential energy expenditure
 - May be due to lower hunger and greater satiety
 - HP (lower GL) may be additionally beneficial to low GI

Conclusions & Limitations

- **Micronutrient Status (iron and zinc)**
- Iron status better maintained on HP red meat diet (NS for zinc)
- **Contribution of the study**
- Young women frequently diet, are at risk of weight gain but weight management studies of this age stage are rare
- First studies in 18-25 y to combine diet, activity & behaviour therapy
 - Nutritionally adequate diet (evidence based)
 - Sound behaviour approach
 - Activity limited 30 min/d (> losses expected with increased activity)
- **Limitations**
- Inadequate power (due to higher attrition)
- Non-blinding of diets

Acknowledgements

Research Team



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Metabolism & Obesity RPAH
Janet Franklin PhD
Elisia Manson RN

Australia Catching up to US Obesity Young Women Leading the Way

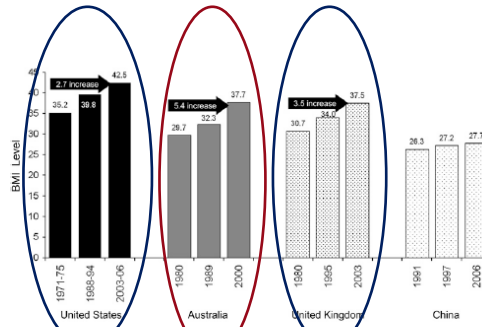


FIGURE 3. Shift in BMI levels (in kg/m²) at the 5th centile for women aged 30 y. Results are on the basis of quantile regression using age and age squared (when significant).

Popkin 2010

Energy Expenditure

	Diet		P Value	
	HP	HC	Diet	D*T
All participants				
EE (MJd ⁻¹)				
Baseline	17.03 ± 0.52	16.63 ± 0.55	0.64	0.48
3 months	16.87 ± 0.58	16.83 ± 0.60		
6 months	16.62 ± 0.69	16.89 ± 0.61		
12 months	16.29 ± 0.85	16.67 ± 0.61		
6 month completers				
EE (MJd ⁻¹)				
Baseline	17.33 ± 0.55	16.56 ± 0.73	0.67	0.64
3 months	17.23 ± 0.67	16.64 ± 0.74		
6 months	16.89 ± 0.85	16.74 ± 0.76		
12 month completers				
EE (MJd ⁻¹)				
Baseline	17.28 ± 0.56	16.72 ± 0.88	0.74	0.97
3 months	17.43 ± 0.73	17.07 ± 0.88		
6 months	17.00 ± 0.87	16.35 ± 0.75		
12 months	16.50 ± 1.17	15.92 ± 0.72		