Physical Activity: Moving Toward Obesity Solutions
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Is exercise an effective strategy for preventing weight gain in adults?: trial evidence

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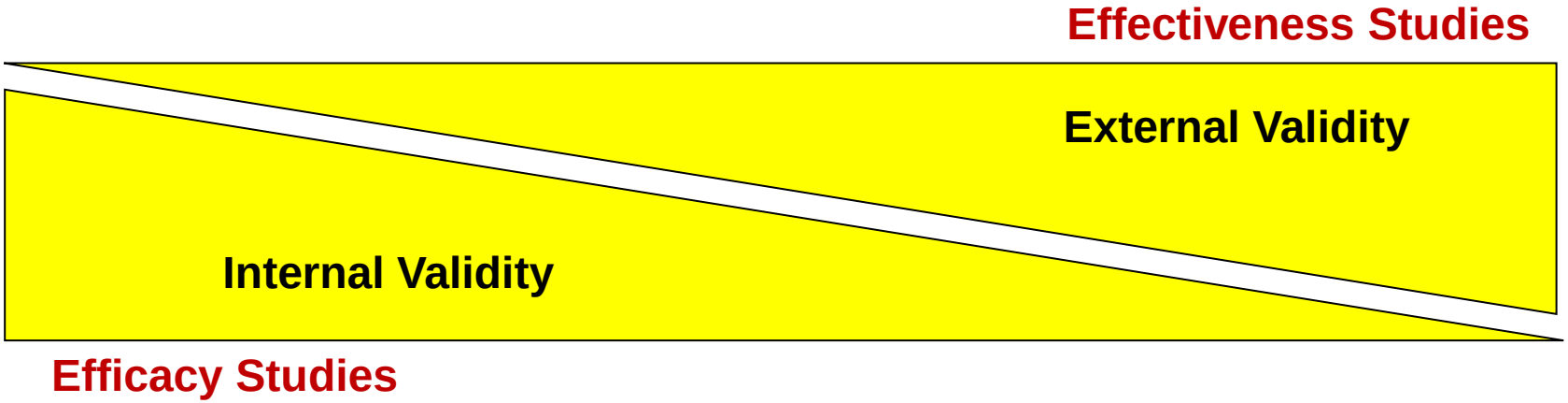
Is exercise an effective strategy for preventing weight gain in adults?

To clarify the question.

What happens when adults exercise / increase physical activity?

What happens when adults are encouraged to exercise / increase physical activity?

Two Types of Randomized Controlled Trials



Efficacy

- Explanatory (cause and effect)

What happens when you increase PA?

Trials primary concerned with physiological response?

Effectiveness

- Pragmatic – more implementation and generalizability questions

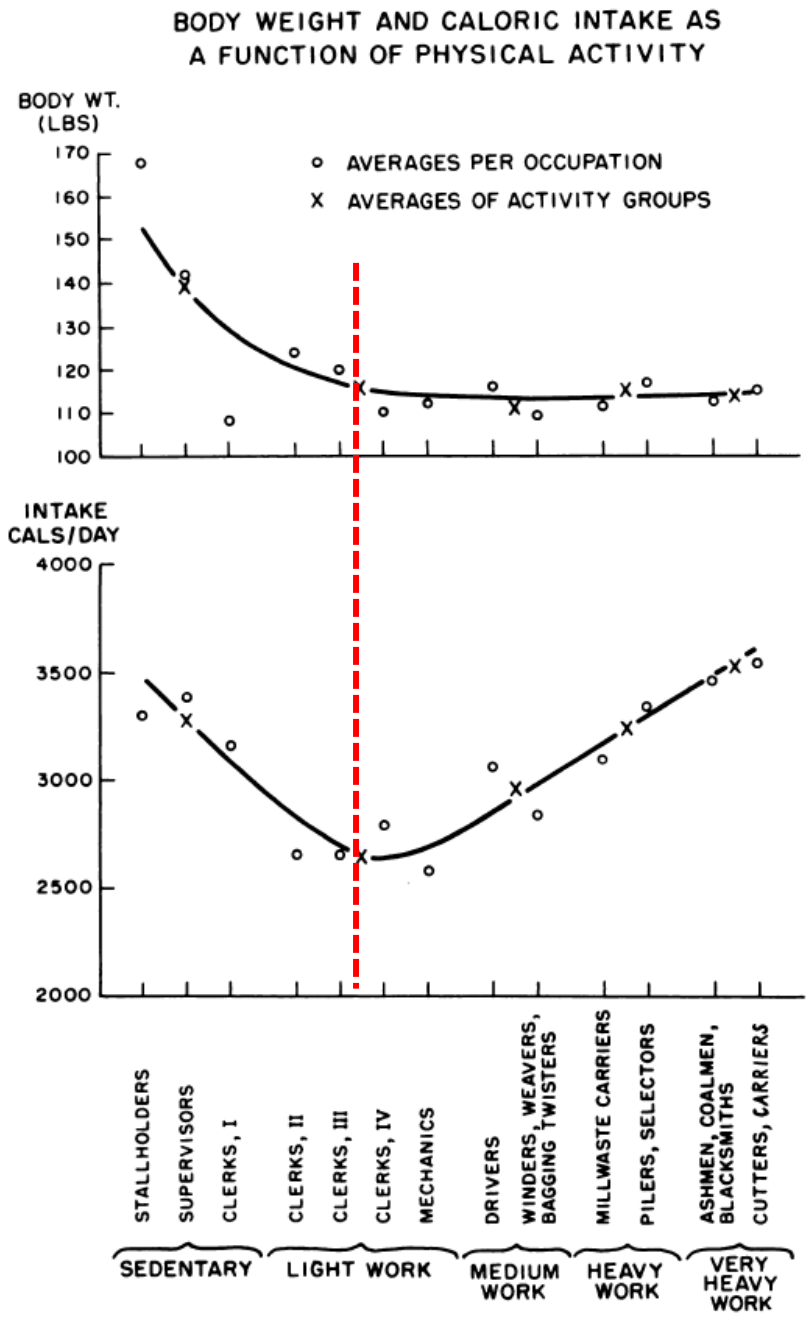
What happens when you are encouraged to increase PA?

Trials primarily concerned with changing behavior

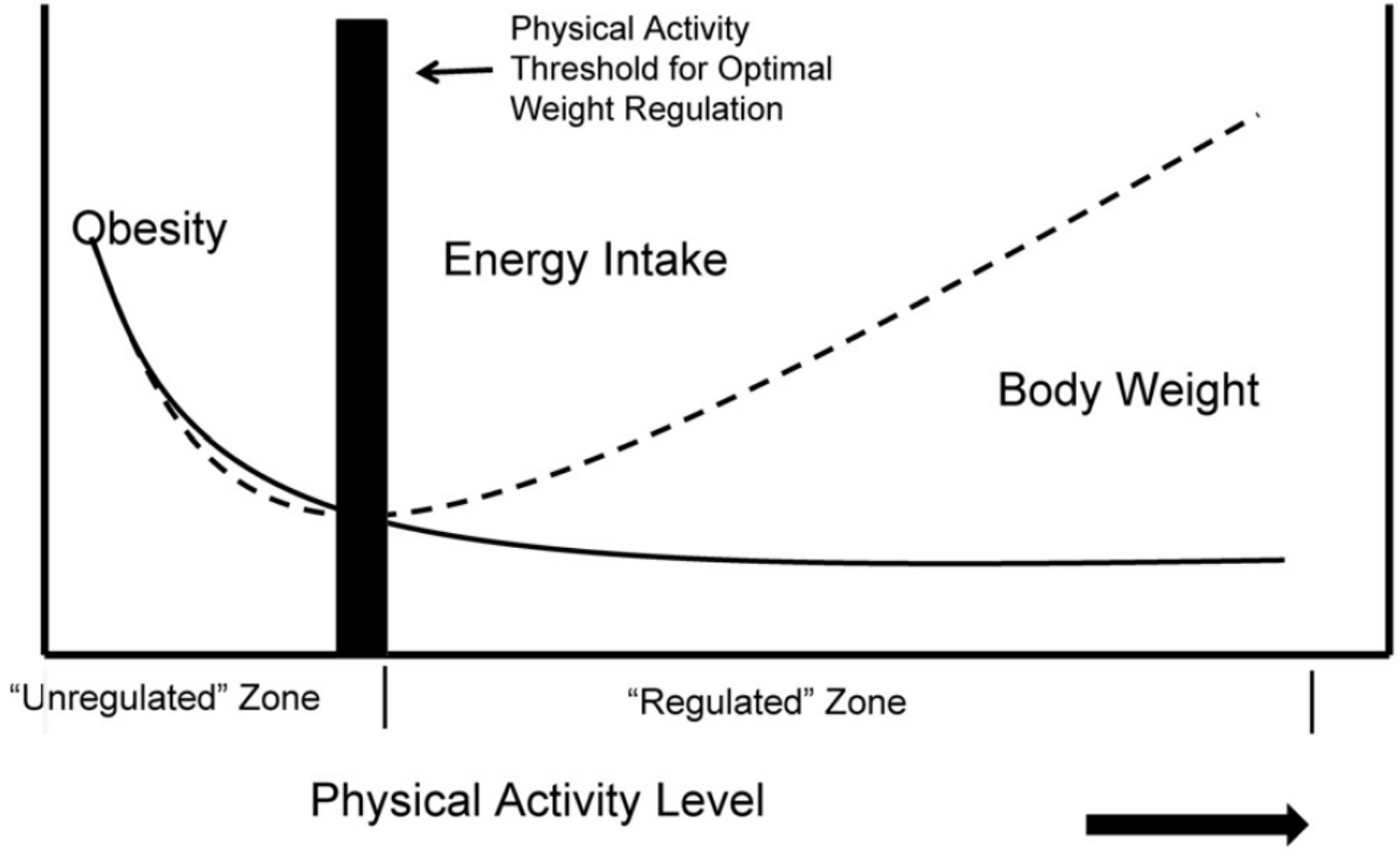
Is exercise an effective strategy for preventing weight gain in adults?

What happens when adults exercise / increase physical activity?

What happens when adults are encouraged to exercise / increase physical activity?

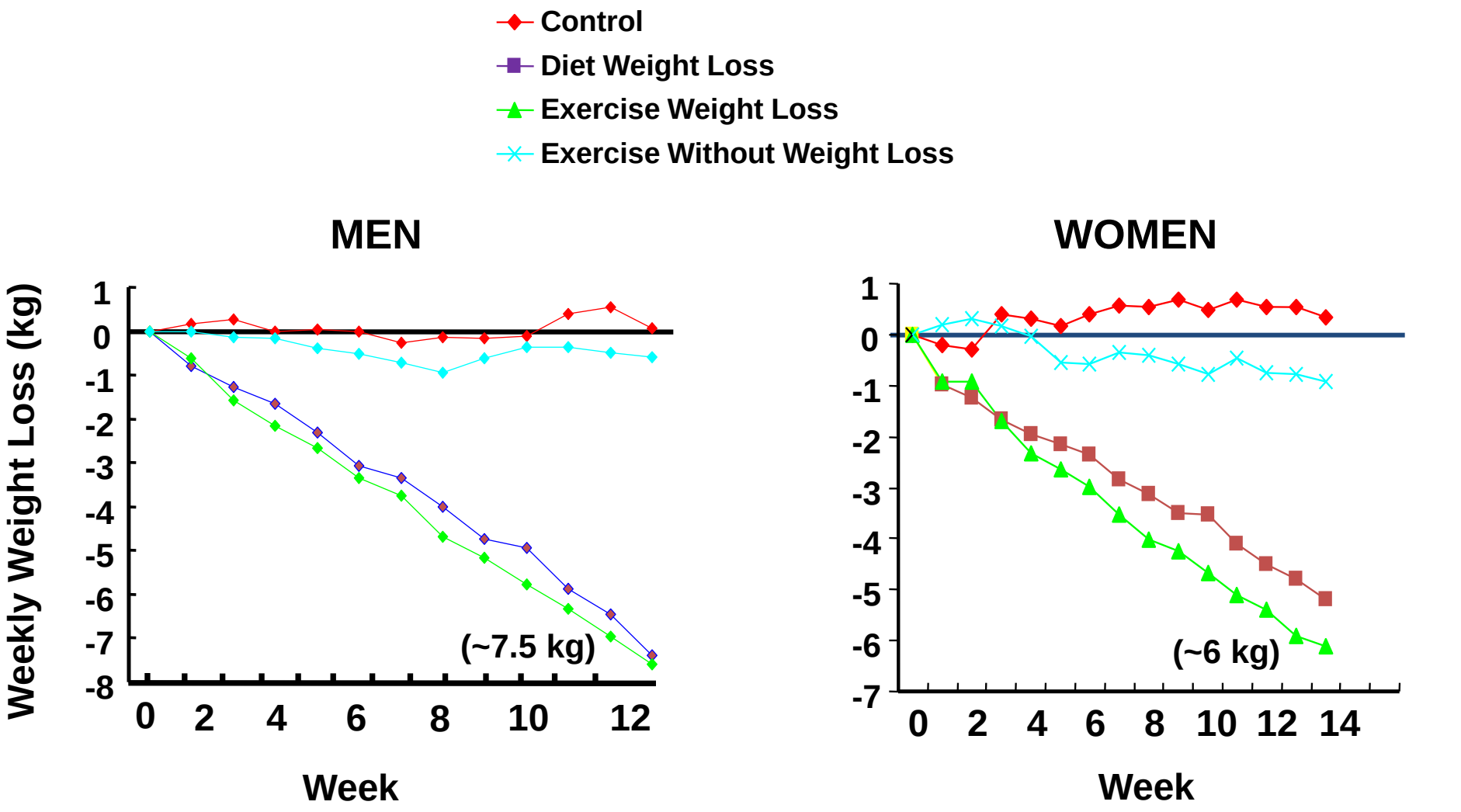


Meyer J et al. Am J Clin Nutr 1956.



Hill J. et al. Circulation, 126:126-132, 2012.

Effects of Diet or Exercise with or Without Weight Loss on Body Weight

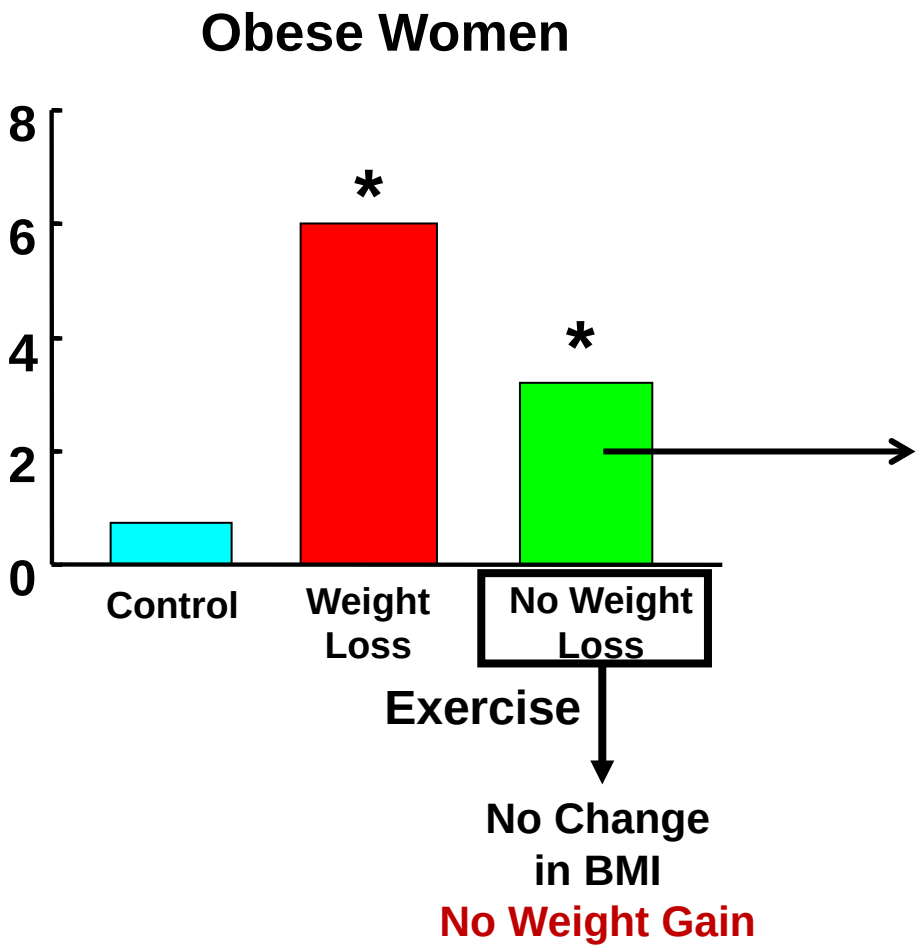


Ross et al. Annals Intern Med 133 (2):92-103, 2000.

Ross et al. Obesity Research 12: 789-798, 2004.

Effects of Exercise (4 mo) With or Without Weight Loss on Waist Circumference in Obese Men and Women

* p<0.05 vs Control



Exercise-induced energy expenditure (exercise) averaged 500 kcal / per day / 4 months: 60 minutes

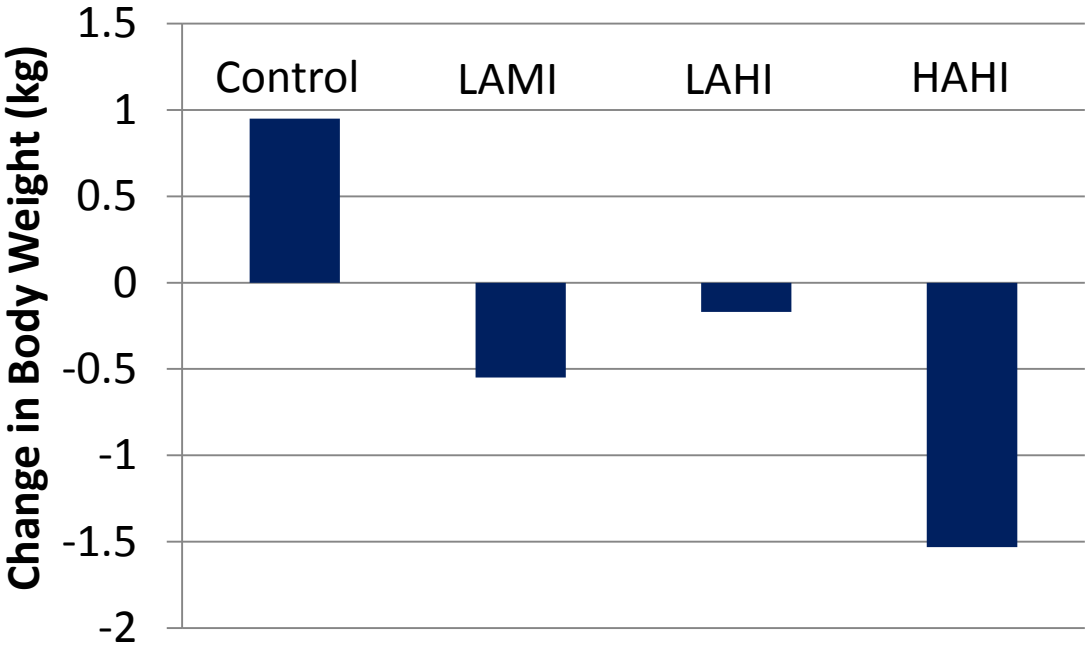
Consumed about 500-600 additional calories per day to try an offset the negative energy balance induced by daily exercise to maintain weight

Ross et al. Obesity Research 2004
Ross et al. Annals Intern Med 2000

Effects of amount and intensity of exercise on blood lipids

Kraus W. et al NEJM 347: 1483, 2002

LALI = low amount, moderate intensity
LAHI = low amount, high intensity
HAHI = high amount, high intensity



….“subjects were counseled to maintain body weight..[eat more]…”

Exercise (6 mo)	LAMI	LAHI	HAHI
Miles / wk	11	11	17
Min / wk	**176**	**117**	**174**

Effects of exercise amount and intensity on abdominal obesity and glucose tolerance in 300 obese adults

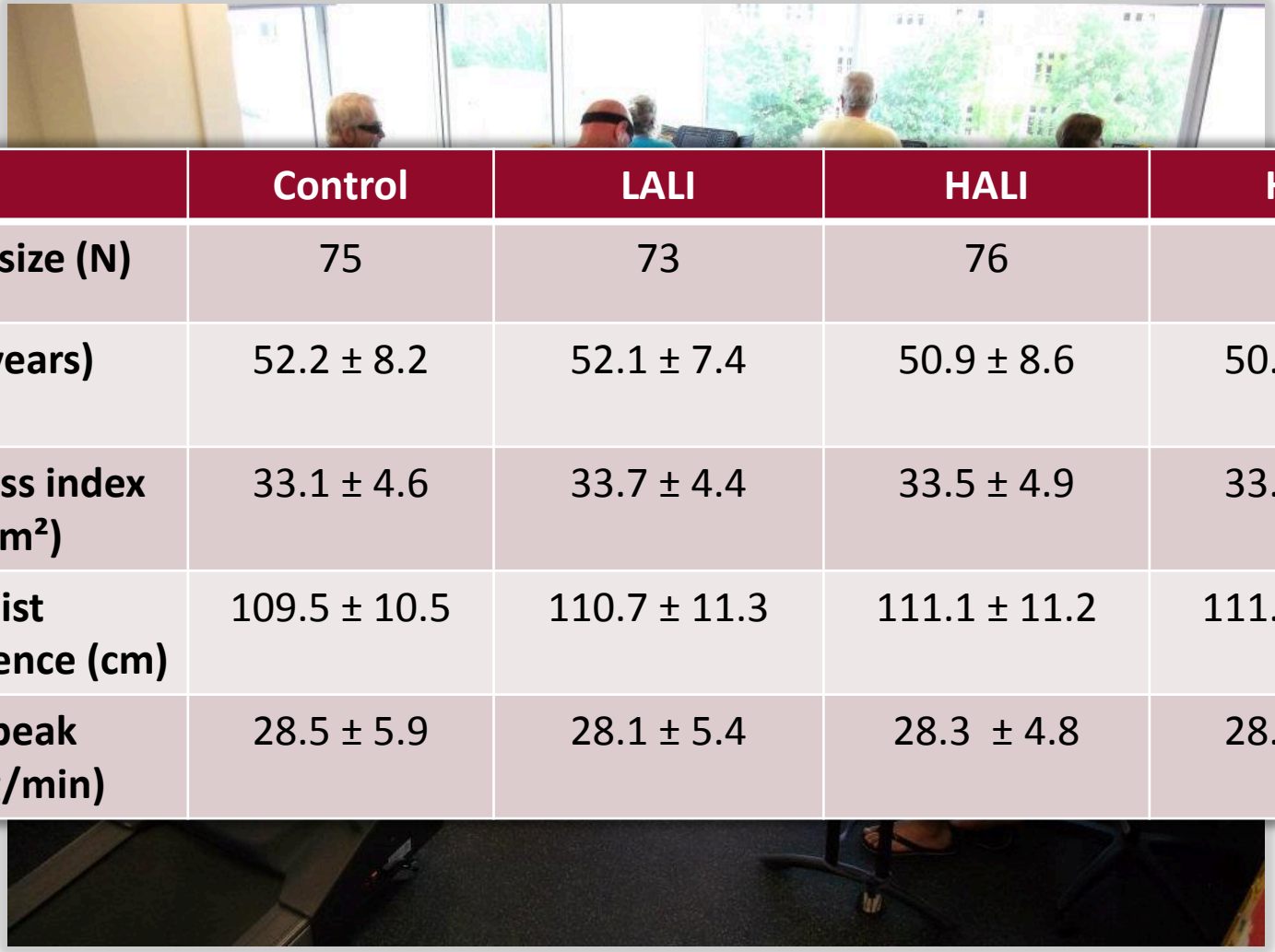
Treatment

All participants exercise 5d/wk for 6 months under supervision

All participants received personalized diet counseling – asked to maintain baseline energy intake (eat no more) throughout intervention.

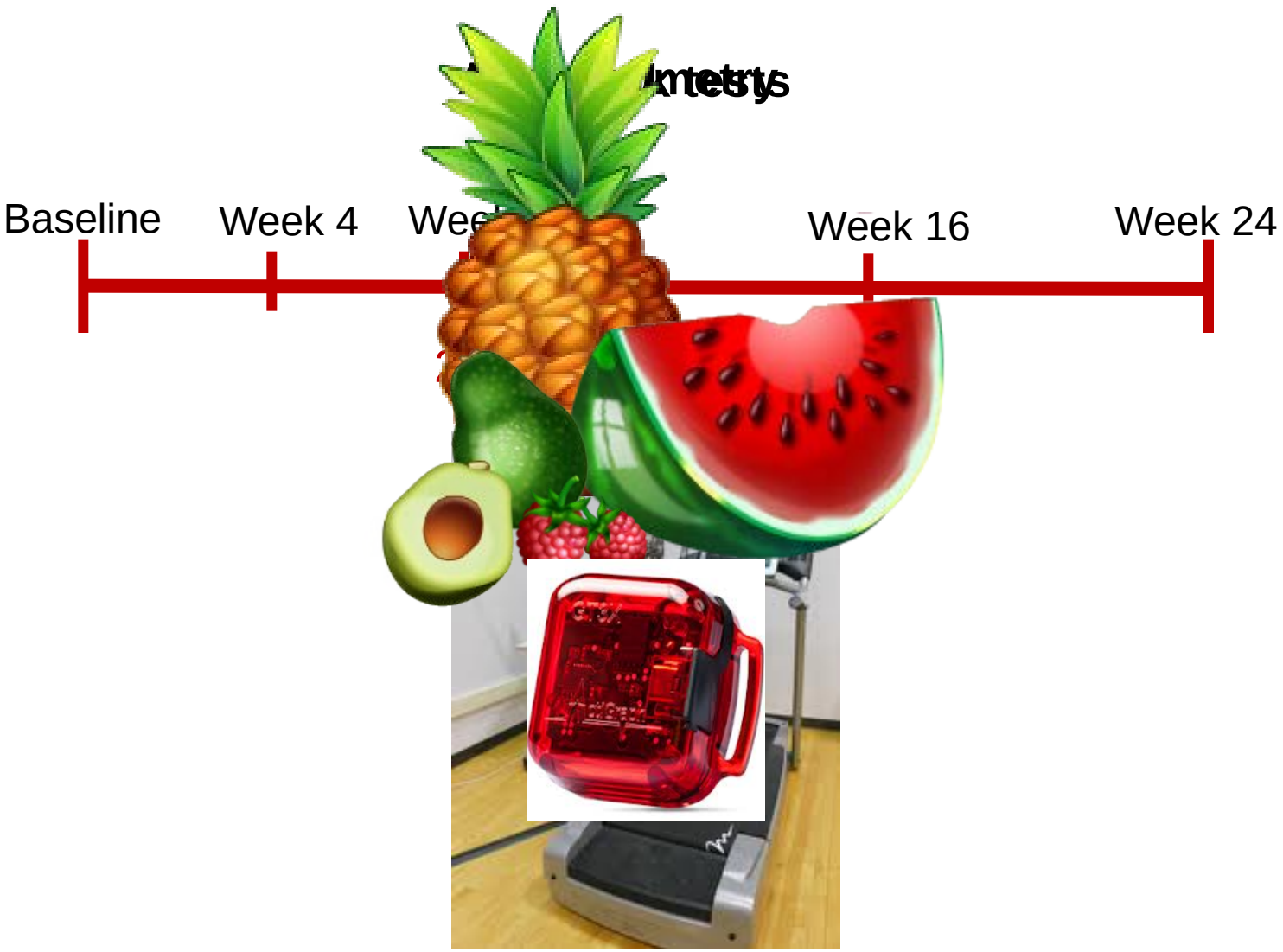
Ann Intern Med 2015; 162: 325-334.

Participant Characteristics

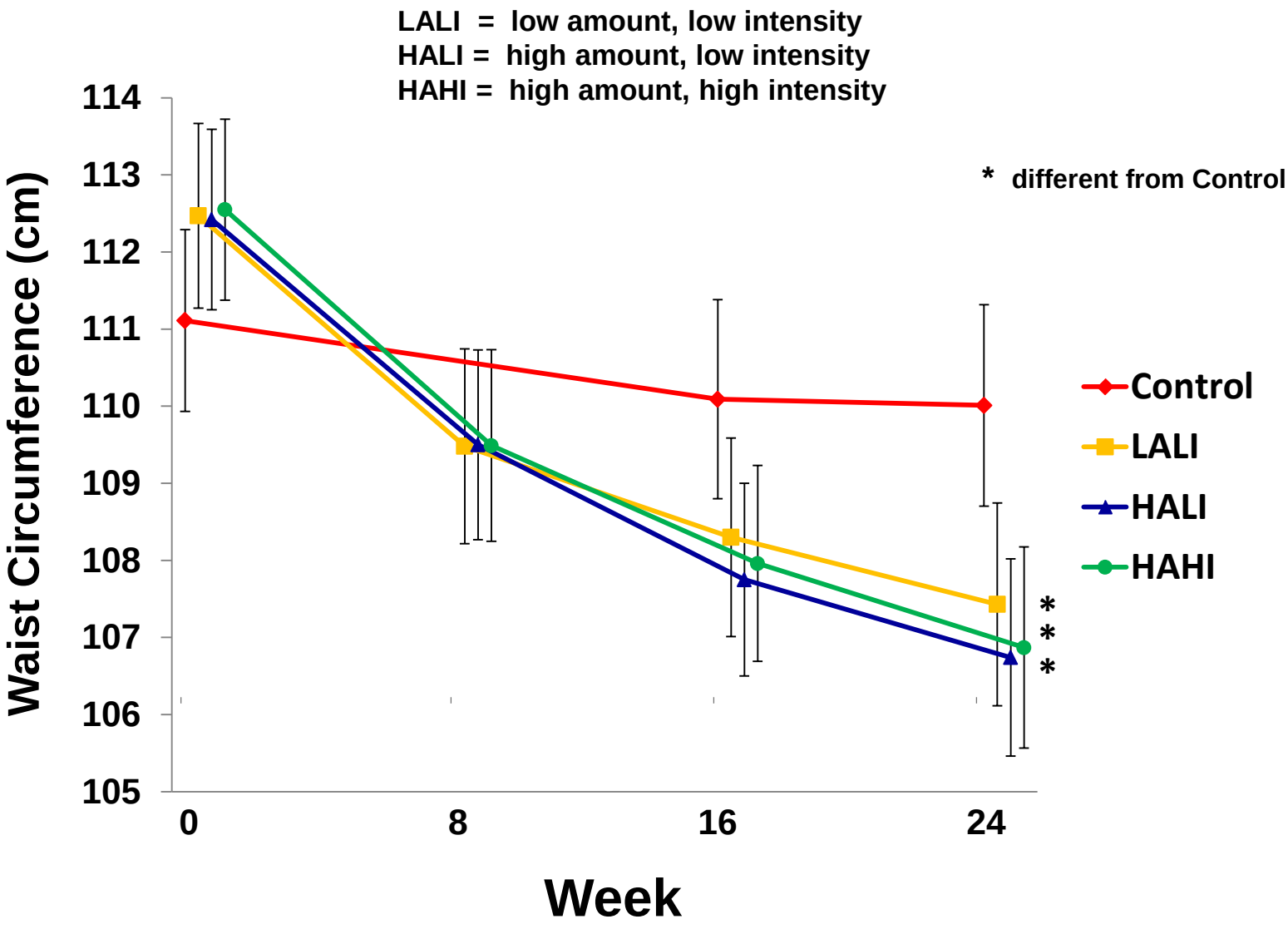


	Control	LALI	HALI	HAHI
Sample size (N)	75	73	76	76
Age (years)	52.2 ± 8.2	52.1 ± 7.4	50.9 ± 8.6	50.3 ± 8.1
Body mass index (kg/m^2)	33.1 ± 4.6	33.7 ± 4.4	33.5 ± 4.9	33.4 ± 4.3
Waist circumference (cm)	109.5 ± 10.5	110.7 ± 11.3	111.1 ± 11.2	111.3 ± 12.1
VO_2 peak (ml/kg/min)	28.5 ± 5.9	28.1 ± 5.4	28.3 ± 4.8	28.1 ± 5.6

Trial Design



Change in Waist Circumference

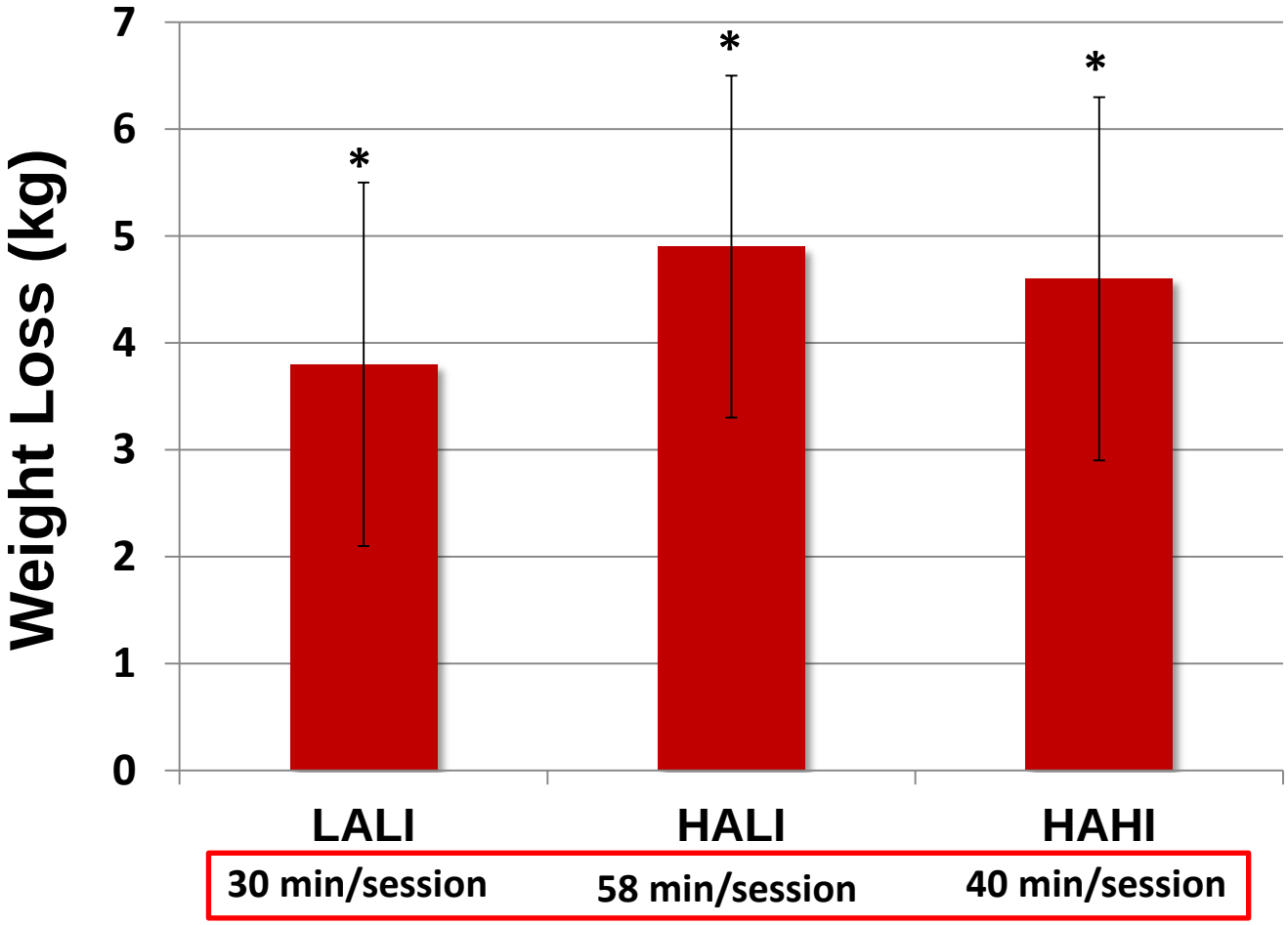


Values are least-squares estimated means adjusted for age and sex

Change in Body Weight at 24 Weeks

* different from Control

LALI = low amount, low intensity
HALI = high amount, low intensity
HAHI = high amount, high intensity



Daily Unstructured Physical Activity

	Change in Unstructured Physical Activity at 24 weeks (minutes)
Control (n= 75)	-2 (-23 to 21)
LALI (n= 73)	-3 (-24 to 18)
HALI (n= 76)	4 (-15 to 24)
HAHI (n= 76)	11 (-11 to 33)

Is exercise an effective strategy for preventing weight gain in adults?

What happens when adults exercise / increase physical activity? **Efficacy RCTs**

Without compensation (eat no more) in caloric intake – weight loss

With compensation in caloric intake – prevention of weight gain

These observations in response to exercise consistent with consensus guidelines

Is exercise an effective strategy for preventing weight gain in adults?

What happens when adults exercise? **Efficacy**

What happens when adults are asked to exercise? **Effectiveness**

A systematic review of interventions aimed at the prevention of weight gain in adults

Lombard CB., et al. Public Health Nutrition 12(11): 2236, 2009.

Five databases searched to July 2008

Nine RCTs : individuals (7 studies), families (1 study), schools (1 study)

Intervention length varied from 13 weeks to 5 years

3 interventions were ≤ 16 weeks, 2 interventions = 1 year, 2 interventions = 2 years
1 intervention = 3 years and 1 intervention = 5 years

Overall, interventions included 375 men and 1595 women

All interventions included diet and physical activity with behaviour change strategies

A systematic review of interventions aimed at the prevention of weight gain in adults

Lombard CB., et al. Public Health Nutrition 12(11): 2236, 2009.

Five studies reported a significant difference between treatment and control between 1.0 and 3.5kg. Largely due to increase in body weight within controls

Not possible to identify successful components of intervention.

More intensive interventions were not always successful

Interventions that included mixed modes of delivery with some personal contact were successful.

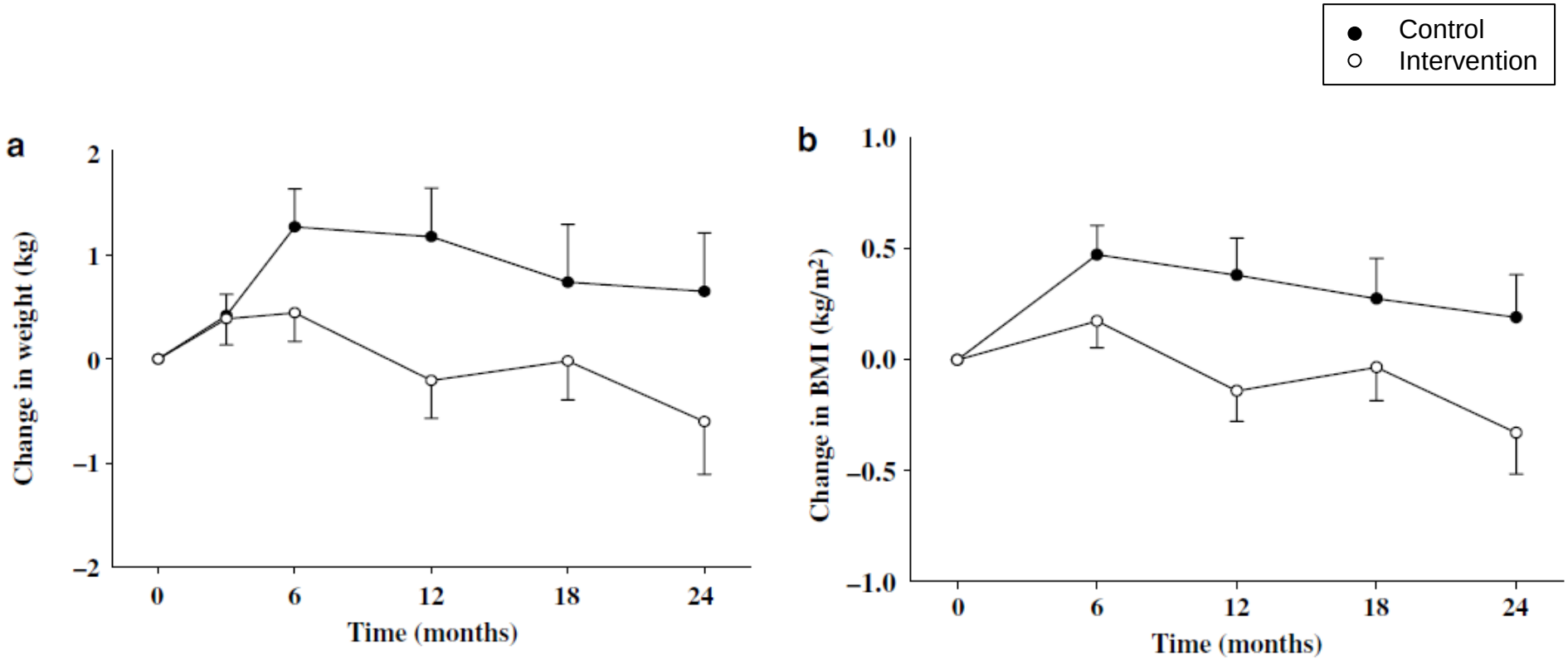
Authors: further large, effective evidence-based programs are urgently required.

Prevention of weight gain in young adults through a seminar-based intervention program

Hivert M-F, Langlois M-F, Berard P, Cuerrier J-P, Carpenter AC *Int J Obes* (2007)

- Participants: 150 healthy, non-obese freshmen medical students
- Intervention: 23 seminars on physical activity, diet, and behaviour
- Duration: 24 months

Primary Findings



- Weight change: 1.3 kg between groups

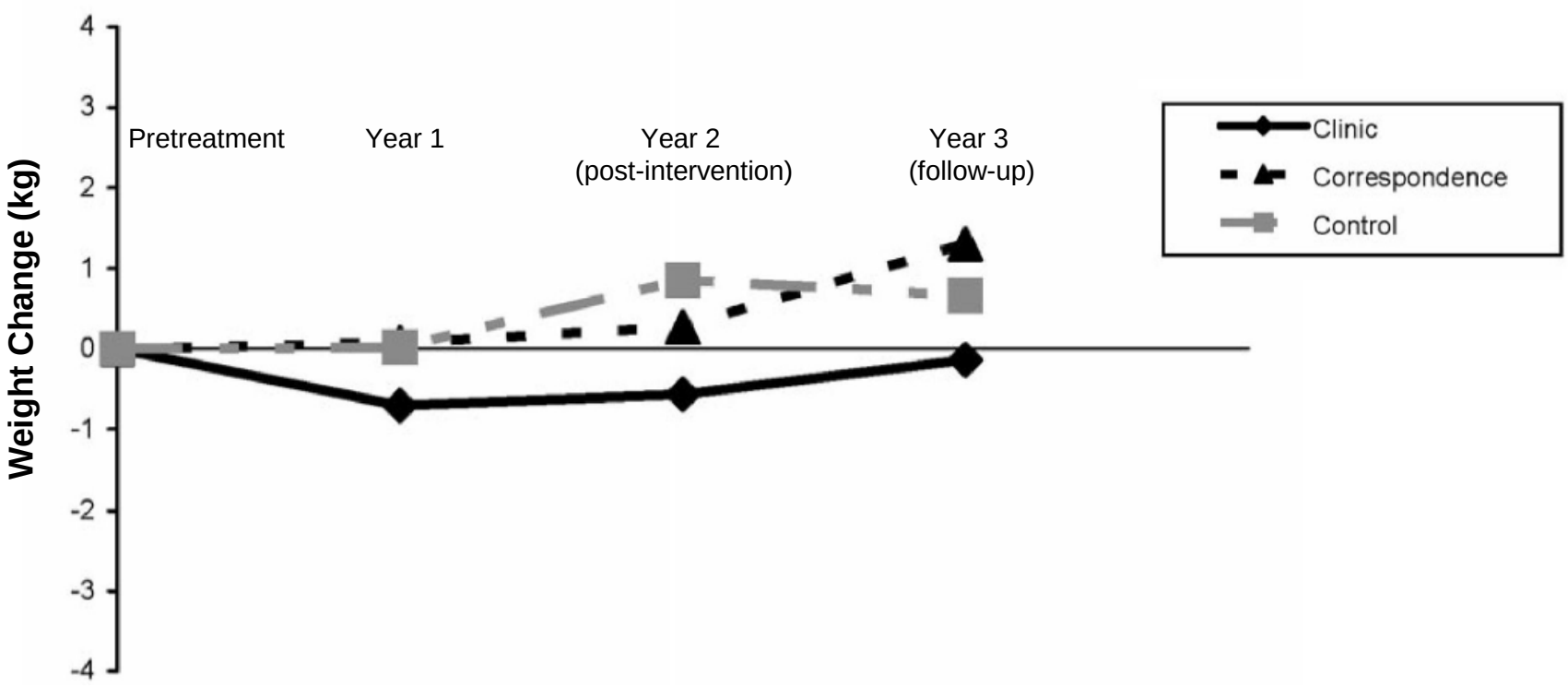
- Secondary findings: <u>No difference in fitness, physical activity, or caloric intake between groups</u>
  - Plasma triglycerides increased in the control group, decreased in the intervention group

Weight Gain Prevention among Women

Levine MD, Klem ML, Kalarchian MA, Wing RR, Weissfeld L, Qin L, Marcus MD. Obesity (2007)

- Participants: 284 healthy women, BMI < 30
- Intervention: **3 groups**: clinic-based (15 visits + individual counselling if weight gain occurred), correspondence course (15 lessons), information-only control (received written information)
- Participants given goals for diet and exercise
- Duration: 2 years with 1 year follow-up

Primary Findings



- Weight Change: no significant difference between all groups
  - Trend towards weight gain in control
  - Small weight loss in clinic group

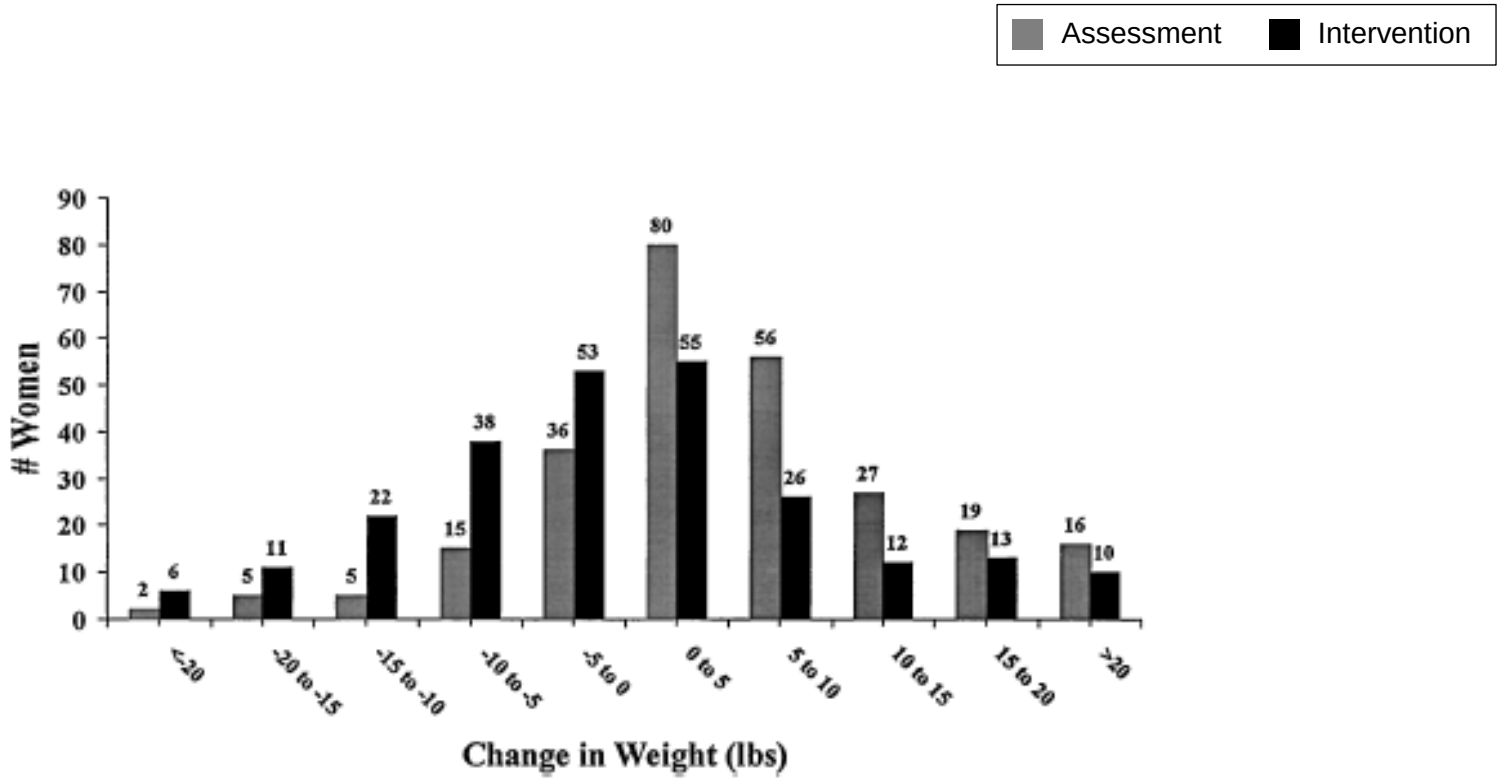
- Secondary Findings: Weight maintenance was associated with increased dietary restraint (conscious thoughts and purposeful behaviour to control intake) and decreased dietary disinhibition (tendency to lose control over eating) over time

Women's Healthy Lifestyle Project: A Randomized Clinical Trial

Kuller LH, Simkin-Silverman LR, Wing RR, Meilahn EN, Ives DG (2001) *Circulation*

- Participants: 535 peri- to postmenopausal women
- Intervention: Intensive sessions for the first 20 weeks, then 1-2 meetings/month for 5 years
  - Objective: keep weight below baseline, encouraged modest weight loss initially
  - Refresher programs offered, cooking classes, group walks, dance classes, incentives and group competitions
  - Individual and group sessions with a psychologist available for those lapsing or gaining weight
- **Duration: 54 months**

Primary Findings



- Weight change: Intervention = -0.1 kg, control gained 2.4kg

- Secondary findings: LDL increased significantly more in assessment group (8.9 mg/dL) vs intervention (3.5 mg/dL)
  - Triglycerides and glucose also increased significantly more in the assessment group vs. intervention

The Effects of Lifestyle Interventions on (Long-Term) Weight Management, Cardiometabolic Risk and Depressive Symptoms in People with Psychotic Disorders: A Meta-Analysis

Jojanneke Bruins[1]*, Frederike Jörg[1,2], Richard Bruggeman[1], Cees Slooff[1,3], Eva Corpeleijn[4], Marieke Pijnenborg[3,5]

Aim: To estimate effects of lifestyle on bodyweight and other cardiometabolic variables in adults with psychotic disorders

Conclusion: Effect sizes for weight gain prevention interventions were large (-0.84 (CI: -1.28 to -0.4kg)) and the effects of the weight loss interventions moderate.

(a) Weight loss intervention studies

All trials prescribed diet and exercise programs , included CBT

Unable to identify component of intervention contributing to weight gain prevention

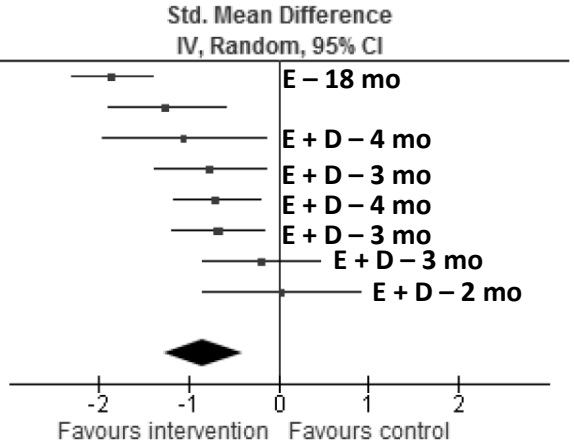
In general the trial quality was poor

(b) Weight gain prevention intervention studies

Study or Subgroup	Std. Mean Difference	SE	Intervention Total	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
Poulin 2007	-1.86	0.2299	59	51	14.5%	-1.86 [-2.31, -1.41]
Evans 2005	-1.25	0.3323	22	22	12.4%	-1.25 [-1.90, -0.60]
Jean-Baptiste 2007	-1.0532	0.461	11	11	9.9%	-1.05 [-1.96, -0.15]
Kwon 2006	-0.76	0.3218	33	15	12.6%	-0.76 [-1.39, -0.13]
Littrell 2003	-0.695	0.2466	35	35	14.2%	-0.69 [-1.18, -0.21]
Alvarez-Jimenez 2006	-0.6708	0.2645	28	33	13.8%	-0.67 [-1.19, -0.15]
Milano 2007	-0.1947	0.3334	22	14	12.4%	-0.19 [-0.85, 0.46]
Scocco 2006	0.0365	0.4495	10	10	10.1%	0.04 [-0.84, 0.92]
Total (95% CI)			**220**	**191**	**100.0%**	**-0.84 [-1.28, -0.40]**

Heterogeneity: $Tau^2 = 0.30$; $Chi^2 = 29.00$, df = 7 (P = 0.0001); $I^2 = 76\%$

Test for overall effect: Z = 3.72 (P = 0.0002)



The birth of ‘small changes’

OBESITY

VIEWPOINT

Obesity and the Environment: Where Do We Go from Here?

James O. Hill,[1]* Holly R. Wyatt,[1] George W. Reed,[2] John C. Peters[3]

The obesity epidemic shows no signs of abating. There is an urgent need to push back against the environmental forces that are producing gradual weight gain in the population. Using data from national surveys, we estimate that affecting energy balance by 100 kilocalories per day (by a combination of reductions in energy intake and increases in physical activity) could prevent weight gain in most of the population. This can be achieved by small changes in behavior, such as 15 minutes per day of walking or eating a few less bites at each meal. Having a specific behavioral target for the prevention of weight gain may be key to arresting the obesity epidemic.

There is no sign that the rapid increase in obesity seen over the past two decades is abating. Recent data from the 1999–2000 National Health and Nutrition Examination Survey (NHANES) (*1*) show that almost 65% of the adult population in the United States is overweight, which is defined as having a body mass index (BMI) greater than 25 kg/m^2, compared to 56% seen in NHANES III, conducted between 1988 and 1994 (*1*). The prevalence of obesity, defined as BMI greater than 30 kg/m^2, has increased dramatically from 23 to 31% over the same time period. Children are not immune to the epidemic, with the prevalence of obesity in children and adolescents up by 36% (from 11 to 15%) during this time. The future is not hopeful unless we act now. BMI distributions estimated from the last two NHANES studies are shown in Fig. 1. When we projected the data to 2008, assuming that weight gain continues at the present rate, we found that the obesity rate in 2008 will be 39%. The rest of the world is catching up. The World Health Organization (WHO) has declared overweight as one of the top ten risk conditions in the world and one of the top five in developed nations (*2*). Worldwide, more than one billion adults are overweight and over 300 million are obese (*2*). Most countries are experiencing dramatic increases in obesity. As an example, the prevalence of overweight individuals in China doubled in women and almost tripled in men from 1989 to 1997 (*3*).

Obesity increases the risk for type 2 diabetes, cardiovascular disease, and some cancers (*4*). Particularly disturbing is the 10-fold increase in incidences of type 2 diabetes among children between 1982 and 1994 (*5*). Obesity has been estimated to account for 5.5 to 7.8% of all health care expenditures (*6*) and to lead to at least 39.2 million lost work days each year (*7*).

The Rand Institute (*8*) recently reported that obesity is more strongly linked to chronic diseases than living in poverty, smoking, or drinking. This report equated being obese with aging 20 years. Obese individuals spend more on health care and on medications than nonobese individuals (*8*). Overweight and obesity are also associated with increased prevalence of psychological disorders, such as depression (*9*).

What Is Driving the Obesity Epidemic?

There is growing agreement among experts that the environment, rather than biology, is driving this epidemic (*10*, *11*). Biology clearly contributes to individual differences in weight and height, but the rapid weight gain that has occurred over the past 3 decades is a result of the changing environment. The current environment in the United States encourages consumption of energy and discourages expenditure of energy (*10*, *11*). Possible factors in the environment that promote overconsumption of energy include the easy availability of a wide variety of good-tasting, inexpensive, energy-dense foods and the serving of these foods in large portions. Other environmental factors tend to reduce total energy expenditure by reducing physical activity. These include reductions in jobs requiring physical labor, reduction in energy expenditures at school and in daily living, and an increase in time spent on sedentary activities such as watching television, surfing the Web, and playing video games.

Although there is good agreement that the environment is fueling the obesity epidemic, the relative contributions of factors influencing food intake and physical activity are not clear. Numerous changes in both have occurred simultaneously with the rise in obesity, and their magnitude and impact have not been well documented and are probably impossible to estimate retrospectively.

The numerous environmental factors that affect eating and physical activity behaviors may merely be symptoms of deeper social forces that are responsible for our present environment. Our ancestors aspired to create a better life for themselves and their children. This goal meant building a society in which more people would have access to affordable food, the amount of hard physical labor required to subsist would be reduced, and there would be an opportunity to enjoy some leisure time. These aspirational values are the modern version of the Aristotlean “good life.” The assumption is that high productivity will make the “good life” possible and technology will fuel higher productivity. The irony is that technology and the accompanying productivity have created a faster and more stressful pace of life, with time pressures for us all (*12*). In his recent book *The Future of Success* (*13*), author and former U.S. Department of Labor Secretary Robert Reich states that “. . . work is organized and

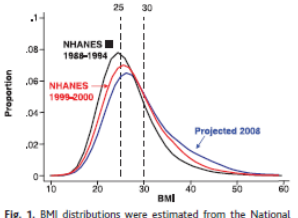


Fig. 1. BMI distributions were estimated from the National Health and Examination Surveys from 1988–94 (NHANES III) and from 1999–2000. Information from these distributions was used to predict the distribution for BMI in 2008. The cut-off points for overweight (BMI = 25) and obesity (BMI = 30) are shown.

[1]Center for Human Nutrition, University of Colorado Health Sciences Center, Denver, CO 80262, USA. [2]Division of Preventive and Behavioral Medicine, Department of Medicine, University of Massachusetts Medical School, Worcester, MA 01655, USA. [3]Procter & Gamble Company, Cincinnati, OH 45252, USA.

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SPECIAL SECTION

Jim Hill, Science 2003

A Family-Based Approach to Preventing Excessive Weight Gain

Rodearmel SJ, Wyatt HR, Barry MJ, Dong F, Pan D, Israel RG, Cho SS, McBurney MI, Hill JO (2006) *Obesity*

- Participants: 105 parents with overweight children
- Intervention: Intervention group (82 families), control group (23 families)
  - Two aims for the intervention group: to increase steps (2000) and increase daily cereal intake (2 servings)
  - Both control and intervention were given pedometers, both required to keep daily food records
- Duration: 13 weeks

A Family-Based Approach to Preventing Excessive Weight Gain

Rodearmel SJ, Wyatt HR, Barry MJ, Dong F, Pan D, Israel RG, Cho SS, McBurney MI, Hill JO (2006) *Obesity*

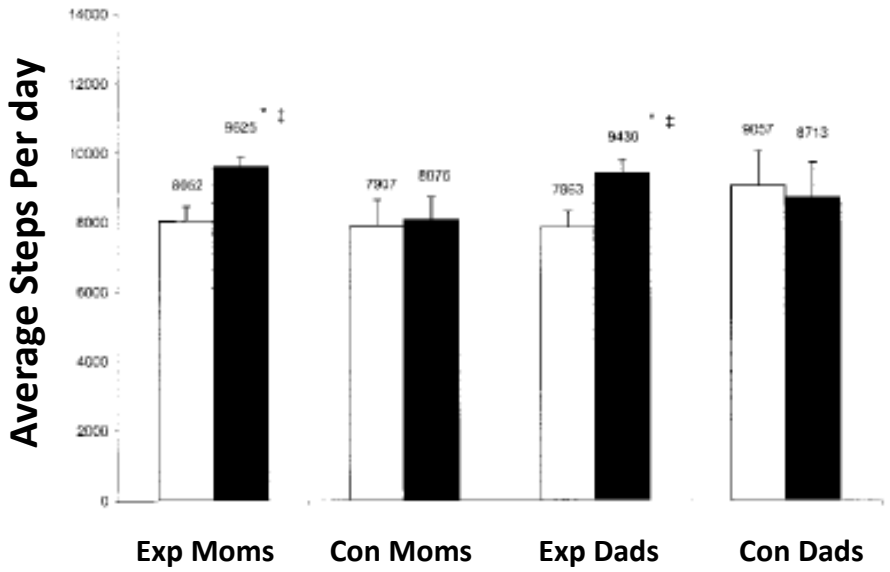


Table 3. Cereal consumption

	EXP		CON	
	Servings/wk	Servings/d	Servings/wk	Servings/d
Parents	7.31 ± 0.04*	1.04*	3.8 ± 0.14	0.54
Target children	8.10 ± 0.17*	1.16*	3.62 ± 0.17	0.52
Other children	7.2 ± 0.07*	1.03*	4.2 ± 0.51	0.60

A Family-Based Approach to Preventing Excessive Weight Gain

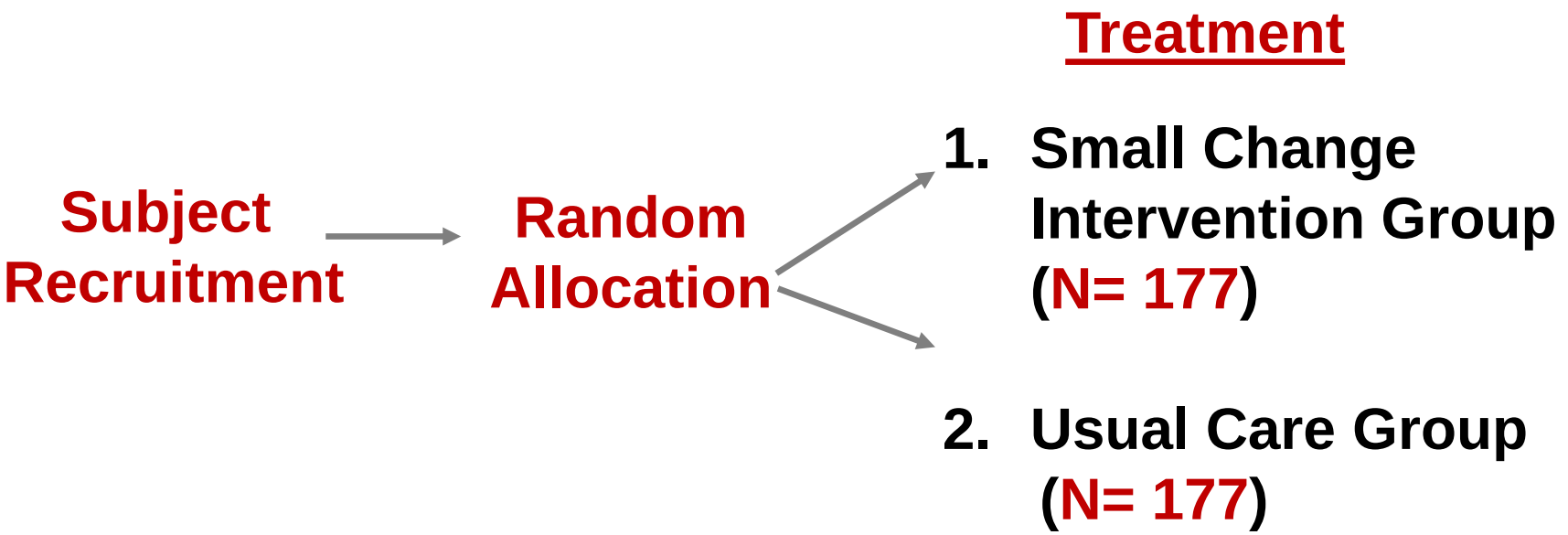
Rodearmel SJ, Wyatt HR, Barry MJ, Dong F, Pan D, Israel RG, Cho SS, McBurney MI, Hill JO (2006) *Obesity*

Table 4 Differences in body weight/adiposity outcomes

		Mean change pre- to post-study			
		EXP	CON	Diff (EXP − CON)	*p* value
Target Children	Weight (kg)	1.50	1.814	−0.314	0.420
	% BMI	−0.65	0.47	−1.116	0.0339
	% Body Fat	−0.51	0.91	−1.414	0.0001
Parents	Weight (kg)	−0.436	0.345	−0.782	0.0390
	% BMI	−0.15	0.13	−0.284	0.0352
	% Body Fat	−0.44	0.14	−0.58	<0.0001
Other Children	Weight (kg)	0.609	1.364	−0.750	0.239
	% BMI	−0.76	0.94	−1.69	0.0358
	% Body Fat	−1.34	2.65	−3.99	0.1657

EXP, experimental; CON, control.

Encouraging a small change approach to sustain healthy behaviors and prevent weight gain



Study Design

Recruit

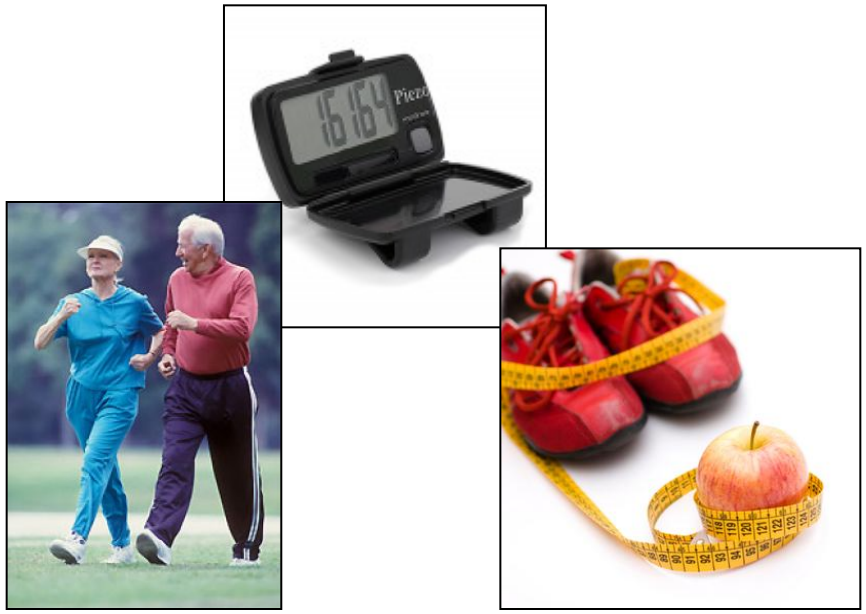
Consent

Pre-testing

~ 2 weeks

24 months of trial

12 months Follow-up



SCA: Small Change Approach

C: Normal Lifestyle

SCA Counselling Sessions Overview

SCA Group will attend counselling sessions with Behavioral Interventionist:

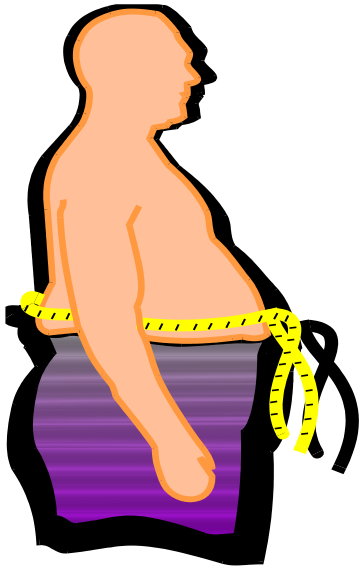
- Provide feedback about small changes
- “Check-Ins” to address individual concerns
- Develop strategies for change
- Skill building
- Goal setting
- Review progress
- On-going maintenance

0-6 Months:	9 Group Sessions 3 1-on-1 Check-ins ~ 10.5 hours
7-12 Months:	5 Group Sessions 1 1-on-1 Check-in ~ 5.5 hours
13-24 Months:	4 Group Sessions 4 1-on-1 Check-ins ~ 6 hours
25-36 Months:	No counselling (maintenance)

Primary Outcomes

Body Weight

Waist Circumference



SUMMARY

Is exercise an effective strategy for preventing weight gain in adults?

What happens when adults exercise / increase physical activity? **Efficacy RCTs**

Without compensation (eat no more) in caloric intake – weight loss

With compensation in caloric intake – prevention of weight gain

Is exercise an effective strategy for preventing weight gain in adults?

What happens when adults are encouraged to exercise / increase physical activity?

Effectiveness RCTs

Existing evidence suggests that lifestyle interventions designed to prevent weight gain are generally effective.

Not possible to identify separate effects of diet and/or exercise on prevention of weight gain.

Insufficient evidence to determine ideal “dose’ of exercise required to prevent weight gain.

Many of the trials are small(n), short term and describe weak experimental designs.

Is exercise an effective strategy for preventing weight gain in adults?

Questions:

1) **Is it possible or important to identify the independent contributions of physical activity and diet for preventing weight gain?**

2) **What are the vital components of the ideal trial to determine the effects of lifestyle as a strategy for prevention of weight gain?**

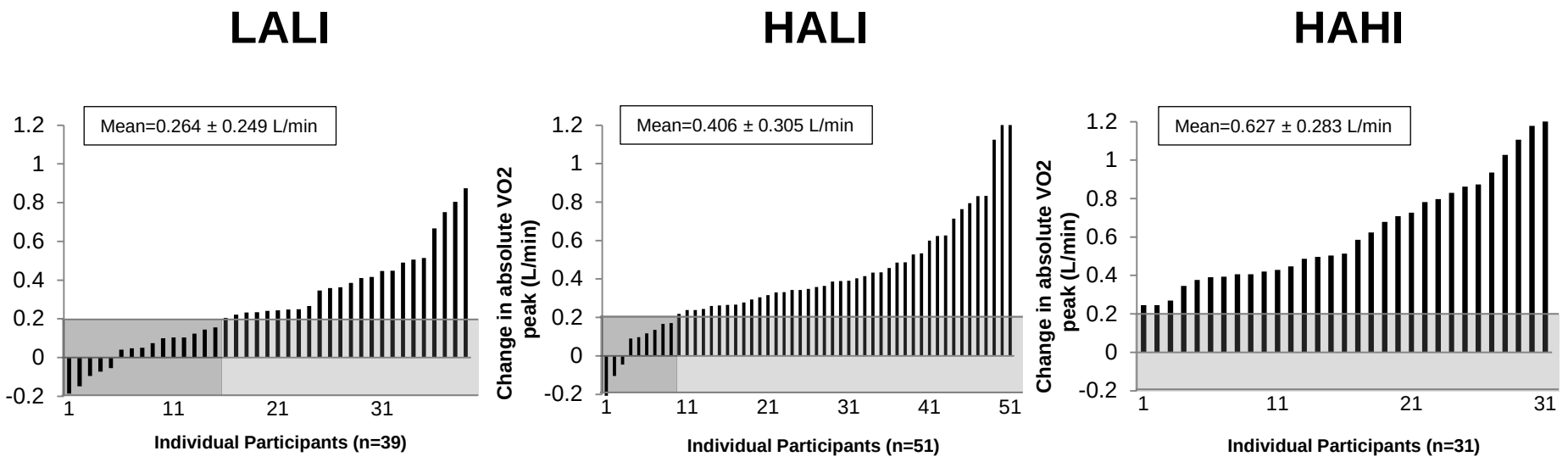
Acknowledgement

Research Funding

Canadian Institutes of Health Research (CIHR)

Thank You

Inter-individual variation in CRF response at 24 weeks to standardized exercise: effects of exercise amount and intensity



Lifestyle and Cardiometabolic Research Unit

Staff….





Students….



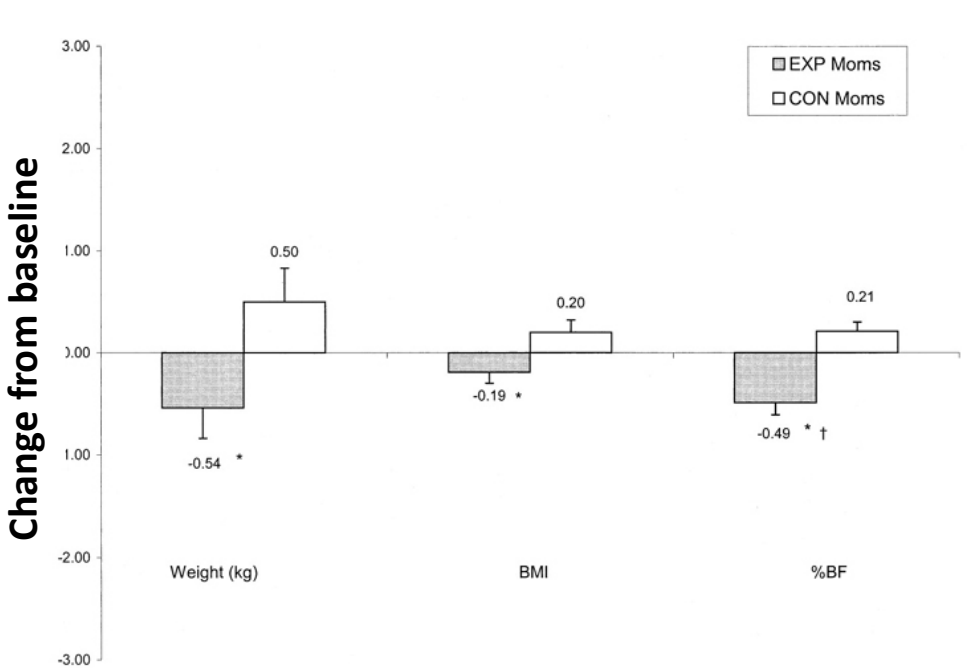


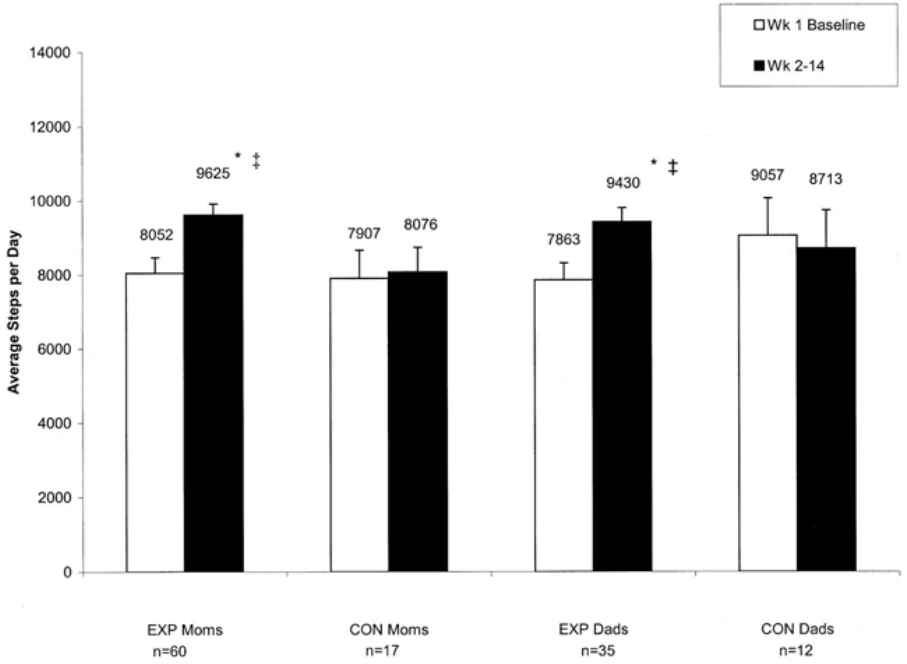
Physical activity and nutrition programs for couples: A randomized controlled trial

Burke V, Giangiulio N, Gillam HF, Beilin LJ, Houghton S *J Clin Epidemiol* (2003)

- Participants: 137 couples
- Intervention: **Three groups**: low level intervention (modules mailed), high-level intervention (half of modules mailed, half delivered at interactive group sessions), control
  - Intervention materials focused on diet and physical activity
- Duration: 4-months with 1 year follow-up

Primary Findings





- Weight change: 0.78 kg between groups
- Secondary findings: Positive effects were seen mostly in mothers and daughters, less so with fathers and sons.
  - <u>Steps per day increased across all intervention family members</u>