



Treadmill Workstations: A Worksite Physical Activity Intervention

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Introduction

- Trends of physical activity (PA)
 - Leisure time PA – Increased
 - Transportation PA – Decreased
 - Domestic PA – Decreased
 - **Occupational PA – Decreased**

Robinson et al. (1999), Steffen et al. (2006), Brownson et al. (2005)

- Occupational PA replaced with increased sitting time



Introduction

- Treadmill Workstations
 - Conventional motorized treadmill
 - Height adjustable sit-to-stand desk
 - Alternate between sitting and slow walking (~1 mph)
- Proposed and built by Edelson to eliminate ‘postural fixity’ *Edelson et al. (1987)*
- Reintroduced as a potential weight loss intervention *Levine et al. (2007)*
- Walking and working (1 mph) expends $119 \text{ kcal} \cdot \text{hr}^{-1}$ more than just sitting
- Levine et al (2007) suggested that replacing 2 to 4 hrs of sitting at work by slow walking may result in an annual weight loss between 20 to 30 kg
- No empirical evidence suggesting that using treadmill workstations can prevent weight gain or result in weight loss



Purpose of Study

To determine if increasing physical activity at the work place through the use of a treadmill workstation favorably influences anthropometric, body composition, cardiovascular, and metabolic variables in overweight and obese office workers.



Treadmill Workstation





Methods

- Participants
 - 12 UT Knoxville faculty/staff (5 males and 7 females)
 - Inclusion criteria
 - Office workers
 - 20 to 65 years of age
 - Body mass index (BMI) over $28 \text{ kg} \cdot \text{m}^{-2}$
 - Able to walk continually for 60 minutes
 - No contraindications to exercise-health history questionnaire



Methods

- Duration of study: 9 months (September/08 to June/09)
- Treadmill Workstations installed in participants' offices
- No recommendations on daily use of treadmill workstations provided
- Outcome variables measured on 3 occasions
 - Before installing Treadmill Workstations
 - 3 months after installing Treadmill Workstations
 - 9 months after installing Treadmill Workstations



Outcome Variables

- Physical Activity
 - *activPAL*TM
 - Accelerometer that senses limb position
 - Discriminates periods of upright activity from seated and lying
 - Gives time spent sitting/lying, standing, stepping, and steps per day
 - 2 days of PA measurement





Outcome Variables



Summary for Subject A session 1 day 1




activPAL Serial Number: 009CA202

Start Time: 08:32 AM 01-May-02

Stop Time: 10:51 PM 01-May-02

Elapsed Time: 14:19

TIME (hrs:min)

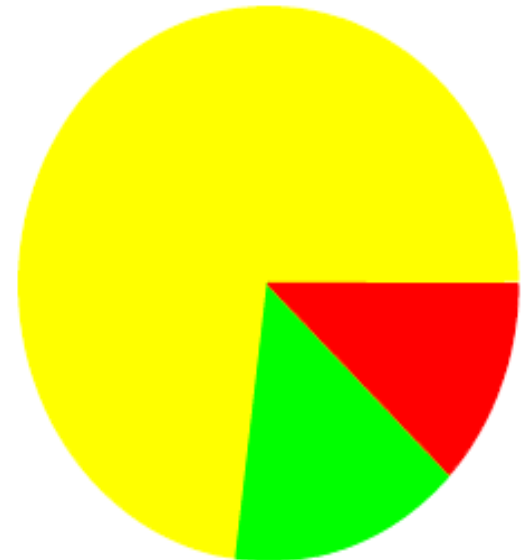
	Sitting/Lying:	10:31	(73%)
	Standing:	02:08	(15%)
	Stepping:	01:39	(12%)

TOTAL NUMBER OF STEPS: 8416

Energy Expenditure: 19.3 MET.h

NUMBER OF UPRIGHT EVENTS: 24

NUMBER OF SEATED/LYING EVENTS: 24





Outcome Variables

- Anthropometric variables
 - Weight
 - Waist and hip circumference
- Body composition (BodPod[®])
 - Percent body fat
 - Total fat mass (kg)
 - Total lean mass (kg)
- Truncal fat mass (DXA)
- Hemodynamics
 - Resting heart rate and blood pressure



Outcome Variables

- Blood sample-overnight fasting
 - Lipid profile (LDL, VLDL, HDL, total cholesterol)
 - Metabolic profile (insulin, plasma glucose, glycosylated hemoglobin)
- Dietary Intake
 - 24-hr interview-based recall
 - 3 days (2 weekdays and 1 weekend day)



Statistical Analyses

- Data distribution dictated the use of parametric or non-parametric tests
- Friedman's Rank tests:
 - Sitting, standing, and walking time, and total steps per day
 - Post hoc Wilcoxon Signed Rank tests with Bonferroni corrections
- One way ANOVA with repeated measures:
 - Weight, BMI, and waist and hip circumferences
 - %body fat, total fat, fat free mass, and truncal fat
 - Resting heart rate and systolic and diastolic blood pressure
 - Serum lipid and metabolic variables dietary
 - Post hoc pair-wise comparisons with Bonferroni corrections

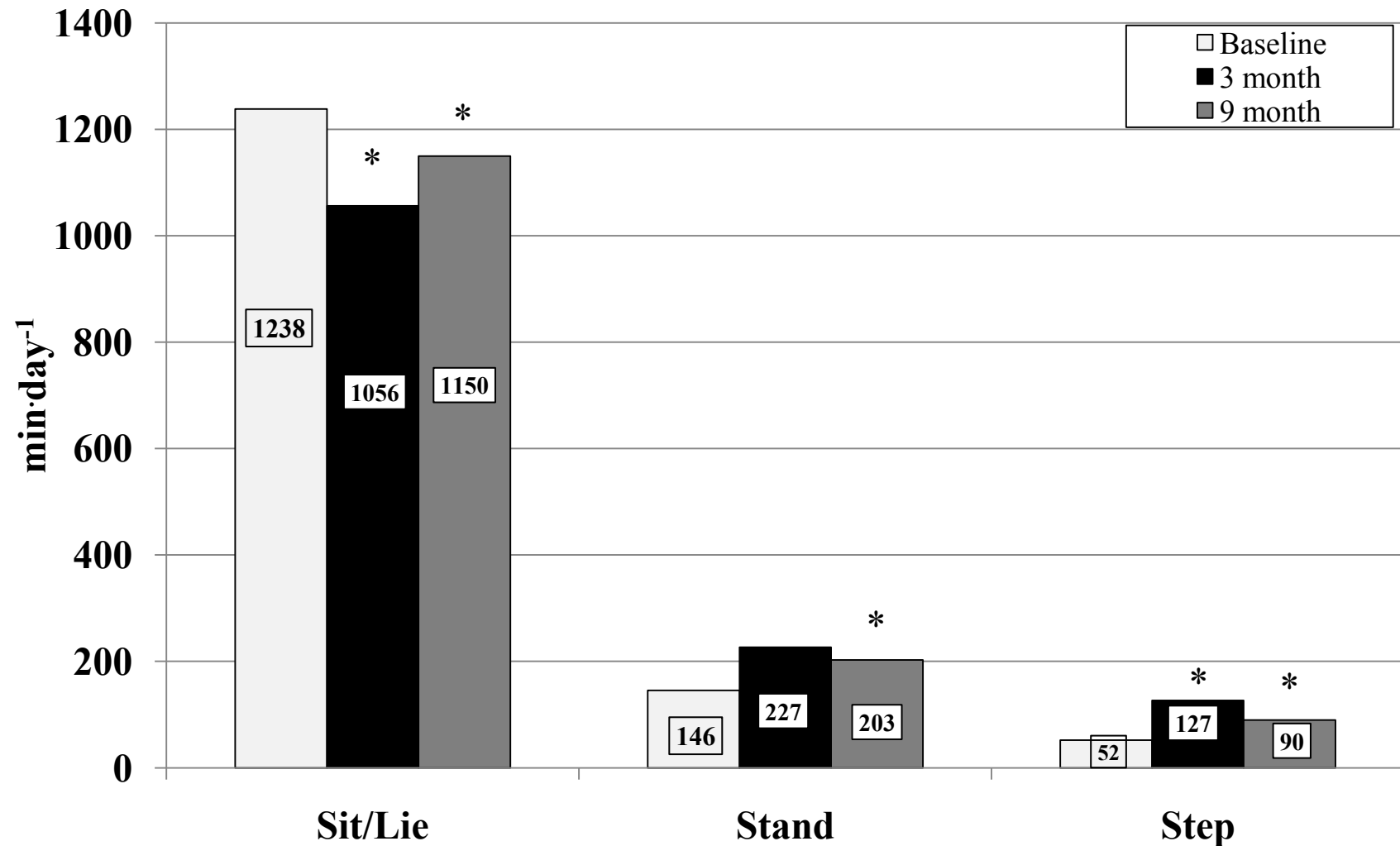


Participant characteristics at baseline ($N=12$). Mean (SD).

	Male	Female
Age (yrs)	47.2 (11.8)	45.6 (7.8)
Height (m)	1.75 (0.05)	1.67 (0.03)
Weight (kg)	103.5 (21.2)	94.4 (15.2)
BMI ($\text{kg}\cdot\text{m}^{-2}$)	33.7 (5.8)	34.0 (4.9)

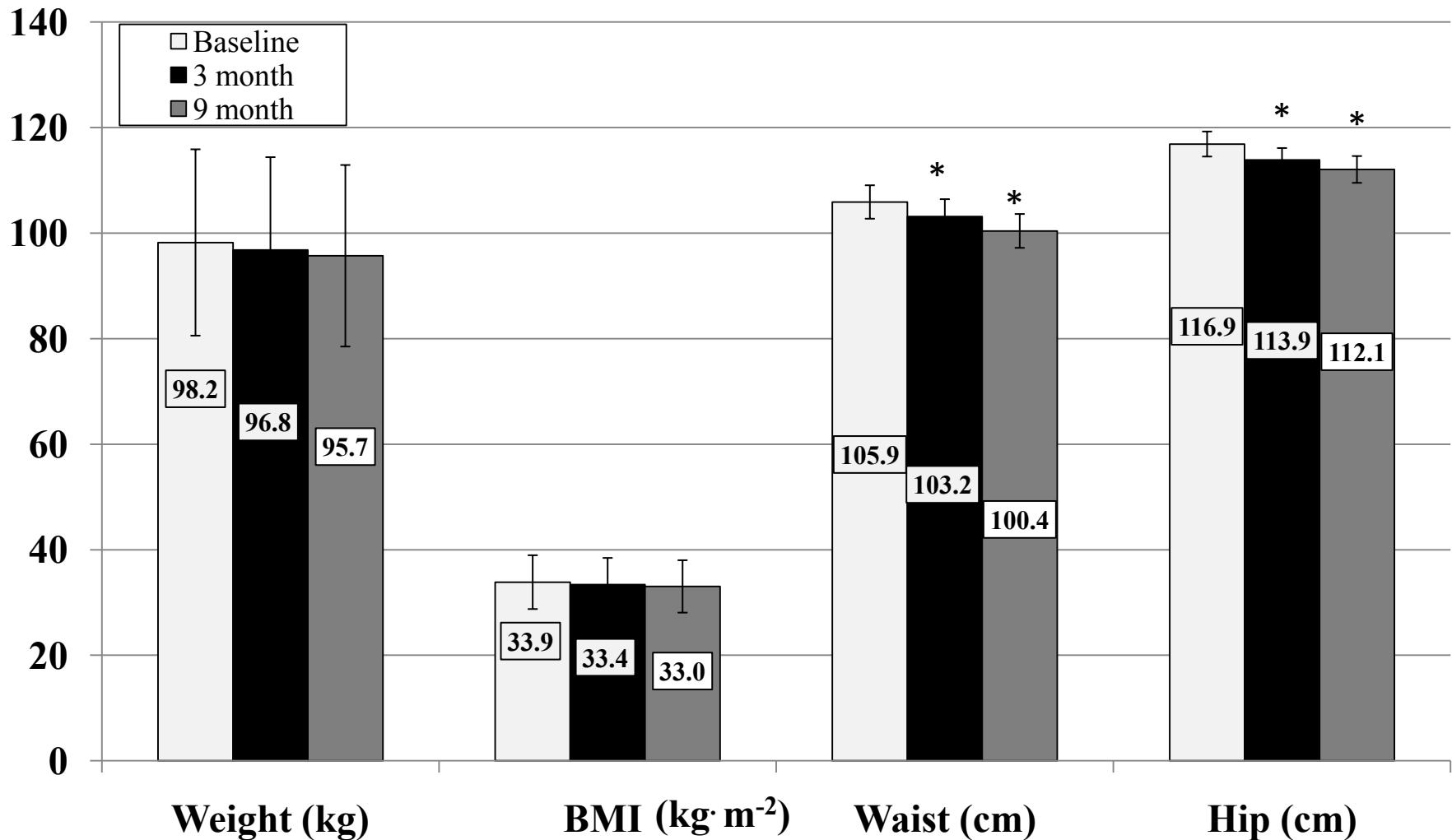


Postural Allocation



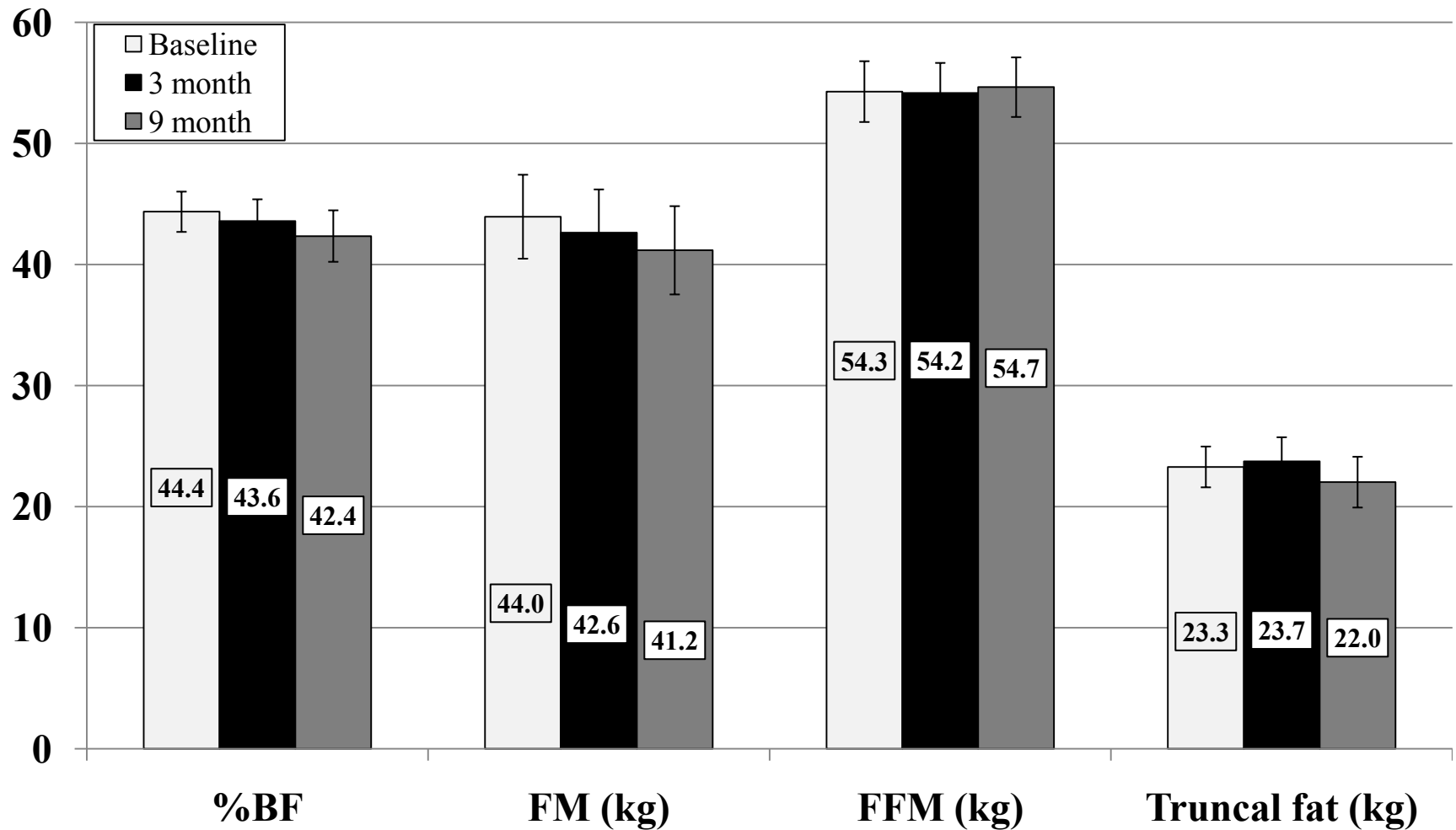


Anthropometrics





Body Composition





Outcome Variables

	Baseline	3-month	9-month
Resting HR (beats·min ⁻¹)	78.0 (11.0)	73.0 (11.0)	72.0 (9.0)
Resting SBP (mmHg)	125.0 (11.0)	119.0 (9.0)	118.0 (9.0)
Resting DBP (mmHg)	77.0 (8.0)	77.0 (8.0)	79.0 (9.0)
LDL (mg·dL ⁻¹ blood)			
HDL (mg·dL ⁻¹ blood)	47.0 (11.0)	47.0 (10.0)	50.0 (8.0)
VLDL (mg·dL ⁻¹ blood)	35.0 (14.0)	32.0 (11.0)	31.0 (11.0)
Total cholesterol (mg·dL ⁻¹ blood)			
Triglycerides (mg·dL ⁻¹ blood)	177.0 (68.0)	159.0 (54.0)	152.0 (54.0)
Insulin (μIU·mL ⁻¹)	13.0 (5.0)	13.0 (6.0)	12.0 (9.0)
Plasma glucose (mg·dL ⁻¹ blood)	95.0 (6.0)	96.0 (9.0)	94.0 (6.0)
Glycosylated hemoglobin (%)			
Total caloric intake (kcal·day ⁻¹)	1889.0 (437.0)	1856.0 (761.0)	1889.0 (515.0)
Total fat intake (g·day ⁻¹)	66.0 (18.0)	67.0 (32.0)	70.0 (29.0)
Fat intake (% calories)	29.5 (3.2)	31.7 (5.2)	32.3 (6.7)
Total saturated fat intake (g·day ⁻¹)	20.0 (7.0)	20.0 (8.0)	23.0 (12.0)
Total cholesterol intake (mg·day ⁻¹)	87.0 (99.0)	100.0 (96.0)	192.0 (141.0)



Discussion and Conclusions

- Participants were not given any recommendations on use
 - Simply installing the treadmill workstation increased upright time by $95 \text{ min} \cdot \text{day}^{-1}$
 - TM workstations provide an option for increasing light intensity activity expenditure at the work place
 - Users may be may be more receptive/adherent
- Similar weight loss observed in other interventions



Discussion and Conclusions

- Accrued health benefits
 - Truncal fat decreased by 1.3 kg
 - Waist decreased by 5.5 cm
 - Total cholesterol classification: ‘borderline high’ to ‘desirable’
 - Improvements in long term glycemic control



Discussion and Conclusions

- Practical implications
 - Increased upright time could result in an additional energy expenditure of approximately $159 \text{ kcal} \cdot \text{day}^{-1}$ over sitting and working
 - It has been suggested that American adults gain approximately 0.6 to 1 kg per year
 - Increasing energy expenditure by approximately $100 \text{ kcal} \cdot \text{day}^{-1}$ could prevent the yearly weight gain in almost all Americans
- Replacing sedentary time with upright time at a treadmill workstation not only prevented weight gain, but also demonstrated weight loss trends.

Hill et al. (2003)



Thank You

The Civilized Man has Built a Coach.....

But Has Lost the Use of His Feet!

- Ralph Waldo Emerson



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