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Can we predict who will lose weight and keep it off long-term?: Using Data-Driven Approaches to Inform Obesity Treatment

September 22, 2021

Moderator
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M. Louise Fitzpatrick College of Nursing

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- **Part 1.** ***Exploring Race, Social Equity and Justice in Health Care: An Interdisciplinary Conversation*** 1-3:30 PM
  - Teresa Turner, MS, RD, LDN, SNS, FAND
  - Cheryl Dennison Himmelfarb, PhD, RD
- **Part 2.** ***Best Practices for Culturally Sensitive Recipe Development***
  - Breana Lai Killeen, MPH, RD
  - Tessa Nguyen, RD, LDN 5-6:30 PM

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Today's Webinar Objectives

- Identify reasons for inter-individual variability in response to weight loss interventions
- Understand factors influencing long-term weight maintenance and weight gain
- Discuss implications for future interventions and obesity treatment strategies

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Continuing Education Credit Details

- Villanova University M. Louise Fitzpatrick College of Nursing is accredited as a provider of nursing continuing professional development by the American Nurses Credentialing Center's Commission on Accreditation.
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- This webinar awards 1 contact hour for nurses and 1 CPEU for dietitians
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- CDR Performance Indicators: **6.2.3, 6.2.5, 8.3.6, 8.3.7**
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Can we predict who will lose weight and keep it off long-term?: Using Data-Driven Approaches to Inform Obesity Treatment

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Department of Endocrinology, Diabetes and Metabolism

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Can we predict who will Lose Weight and Keep it Off Long-term?: Using Data-Driven Approaches to Inform Obesity Treatment

Danielle M. Ostendorf, PhD
Danielle.Ostendorf@cuanschutz.edu

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Outline

- **Challenges in obesity prevention and treatment: inter-individual variability**
- **Discuss the value of using data-driven approaches to study this variability**
- **Describe the behavioral weight loss trial, intervention, and study participants**
- **Describe the statistical analysis**
- **Share the primary study findings**
- **Implications for future interventions and obesity treatment strategies**

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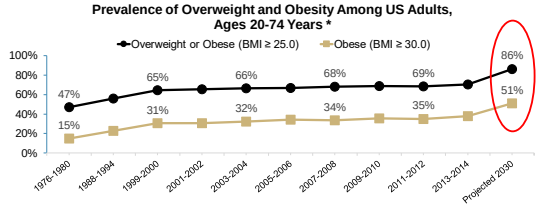
Epidemiology of Obesity

Prevalence of Overweight and Obesity Among US Adults, Ages 20-74 Years *



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SOURCE: NCHS, National Health and Nutrition Examination Survey.
*Age-adjusted by the direct method to the year 2000 U.S. Bureau of the Census estimates using the age groups 20-34, 35-44, 45-54, 55-64, and 65-74 years.

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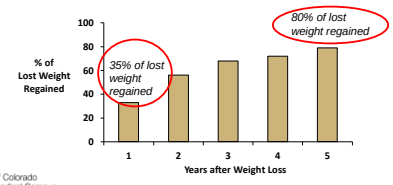
Challenges in Obesity Treatment

- Weight loss is hard
- Weight loss maintenance is even harder



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Adapted from Anderson et al., (2001) AJCN.

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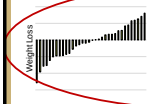
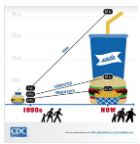
Why is Obesity Treatment So Challenging?



- Individual variability in response to treatment(s)
- Individual differences in program adherence
- Physiological adaptations of counter regulatory mechanisms that promote weight regain
- Obesogenic environment



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Bray and Wadden (2015), *Obesity*

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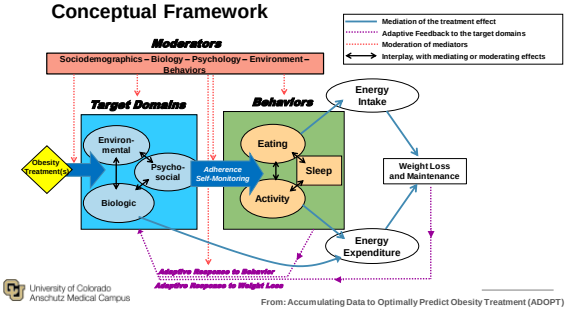
Conceptual Framework



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From: Accumulating Data to Optimally Predict Obesity Treatment (ADOPT)

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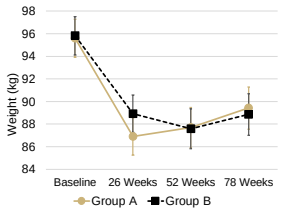
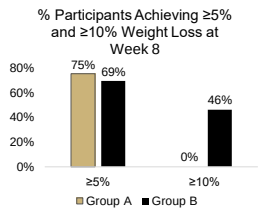
Traditional Analytical Approaches in Obesity Research





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Adapted from Catenacci et al., (2019) *Obesity*; and Catenacci et al. (2016) *Obesity*

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Application of Data-Driven Approaches in Obesity Research

Data-driven approaches:

- Identify multiple unobserved sub-populations in the sample who demonstrate similar patterns of weight change over time
- Can describe longitudinal change within each unobserved sub-population
- Allow us to examine differences between sub-populations

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Ram et al., (2013) *Int J Behav Dev*

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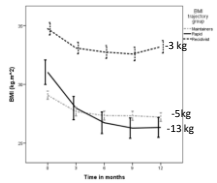
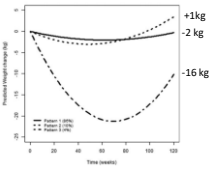
Identifying Weight Loss Trajectories: Lifestyle Weight Loss Interventions



- n=231 adults (primarily white, female) who received a 12-mo dietary weight loss program
- Rapid losers and maintainers were older and had lower BMIs compared to recidivists

Batterham et al., (2016) *University of Wollongong Research Online*



- n=604 Black American adults (primarily female) who received a lifestyle weight loss program
- Having a higher BMI predicted having pattern 2 or 3; higher dietary fat score predicted lower odds of having patterns 2 or 3

Morales et al., (2014) *Obesity*

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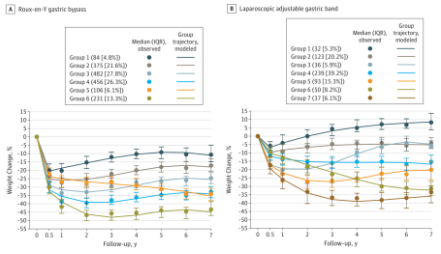
Identifying Weight Loss Trajectories: Bariatric Surgery



- n=2348 adults (n=1738 RYGB, n=610 LAGB) who received a lifestyle weight loss program
- RYGB: female, younger age, white race, smoking, higher BMI, not having diabetes, not having low HDL cholesterol, not having hypertension
- Blue text = LAGB

Courcoulas et al., (2018) *JAMA Surg*

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Research Gap

- Few studies have examined a comprehensive array of factors that predict weight change trajectories
- Exploratory analyses are a critical first step towards developing tailored interventions to promote long-term weight loss maintenance

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Research Aims

- Identify groups of individuals with distinct patterns of weight change over 24 months
- Explore differences between groups in sociodemographic, biologic, behavioral, and psychosocial factors

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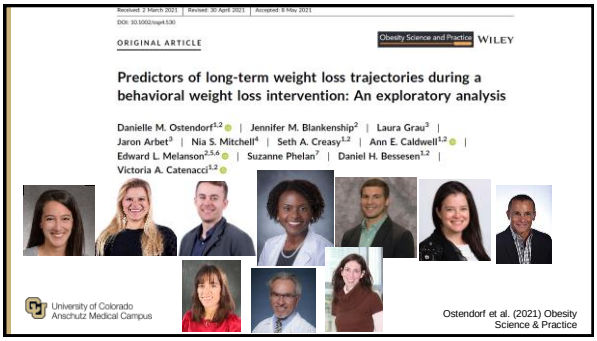
Received: 2 March 2021 | Revised: 30 April 2021 | Accepted: 8 May 2021
DOI: 10.1002/osp4.530
ORIGINAL ARTICLE
Obesity Science and Practice WILEY

Predictors of long-term weight loss trajectories during a behavioral weight loss intervention: An exploratory analysis

Danielle M. Ostendorf[1,2] | Jennifer M. Blankenship[2] | Laura Grau[3] | Jaron Arbet[3] | Nia S. Mitchell[4] | Seth A. Creasy[1,2] | Ann E. Caldwell[1,2] | Edward L. Melanson[2,5,6] | Suzanne Phelan[7] | Daniel H. Bessesen[1,2] | Victoria A. Catenacci[1,2]

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Ostendorf et al. (2021) Obesity Science & Practice

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Randomized Controlled Weight Loss Trial – "Exercise Timing Study"

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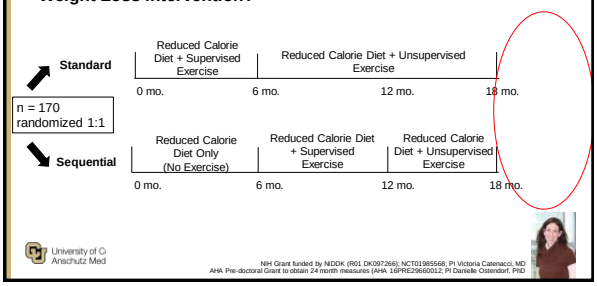
When is the Optimal Time to Add Exercise in a Behavioral Weight Loss Intervention?



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NIH Grant funded by NIDDK (R01 DK097266); NCT01985568; PI Victoria Catenacci, MD
AHA Pre-doctoral Grant to obtain 24 month measures (AHA 16PRE29660012; PI Danielle Ostendorf, PhD

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Exercise Timing Behavioral Weight Loss Intervention

Curriculum

- Colorado Weigh – skills based approach and cognitive behavioral strategies for lifestyle modification
- Led by Registered Dietician
- Weekly classes for weeks 0-20, every other week for weeks 21-26, and every month for weeks 27-78

Dietary Prescription

- Suggested macronutrient content: 50-55% carbohydrates, 20-25% protein, 20-30% fat
- 1200-1800 kcal/day based on estimated energy requirements (Mifflin St. Jeor)

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NIH Grant funded by NIDDK (R01 DK097266); PI Victoria Catenacci, MD

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Exercise Timing Physical Activity Prescription

Prescription

- Gradually increase moderate intensity activity to 300 minutes/wk over 6 month supervised exercise phase, and maintain this level for study duration
- 65-75% Heart Rate Maximum
- Technogym Wellness System Key
- Membership to the Anschutz Health and Wellness Center
- Could choose between treadmill, elliptical, recumbent or upright bike, rower, stepper, or arm ergometer

Behavioral Support

- Structure:
  - 6, 45-min 1:1 support session using standardized curriculum

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NIH Grant funded by NIDDK (R01 DK097266); PI Victoria Catenacci, MD

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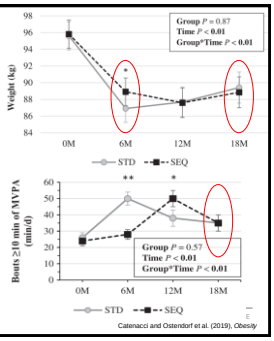
Timing of Exercise Initiation did not Influence Long-term Weight Loss

- Adults randomized to standard demonstrated greater weight loss at 6 months vs. sequential, but no differences at 18 months
- Both immediate and delayed exercise initiation resulted in clinically meaningful weight loss at 18 months.
- Timing of exercise initiation can be based on patient preference.



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Catenacci and Ostendorf et al. (2019), *Obesity*

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170 Total Participants Randomized to Intervention

30 Excluded
29 had fewer than 3 weights
1 outlier for baseline levels of activity

140 Included in Secondary Data Analysis

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Outcome Measures

	Month							
	0	3	6	9	12	15	18	24
Body Weight (calibrated digital scale at clinic)	x	x	x	x	x	x	x	x
Fat Mass, Fat Free Mass (DXA)	x		x		x		x	
Cardiorespiratory Fitness (VO2 Max Test)	x		x		x		x	
Energy Intake and Macronutrient Content –3-day diet diary	x		x		x		x	
MVPA (Sensewear Mini Armband)	x		x		x		x	x
Self-efficacy for Exercise (BARSE)	x		x		x		x	x
Perceived Benefits and Barriers of Exercise (EBBS)	x		x		x		x	x
Exercise motivation (BREQ-2)	x		x		x		x	x
Eating self-efficacy (WEL)	x		x		x		x	x
Cognitive restraint, hunger, disinhibition (TFEI)	x		x		x		x	x
Weight management behaviors (EBI-revised)	x		x		x		x	x
Motivation for engaging in weight loss treatment (TSRQ)	x		x		x		x	x
Depressive symptoms (CES-D)	x		x		x		x	x

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Statistical Analysis

- Identified distinct clusters of longitudinal weight change trajectories over 24 months (latent class growth mixture model)
- Estimated models estimated iteratively – we increased the number of clusters until the best fitting model was found
- Selected the best fitting model based on the model with the lowest Bayesian Information Criterion (BIC) (models with clusters <10 not considered)
- Explored whether baseline levels or change in different factors were associated with trajectory group

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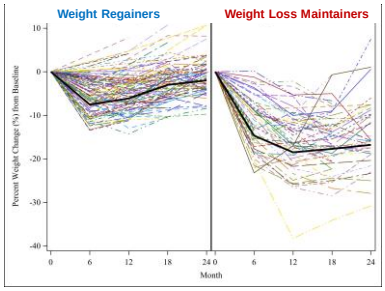
Results: Identified 2 Weight Trajectory Groups



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Baseline Characteristics by Trajectory Group

Characteristic	Weight Regainers (n = 91)	Weight Loss Maintainers (n=49)	P value	FDR adjusted P value
Randomized Group (count (%))			0.38	0.65
Standard	46 (51%)	21 (43%)		
Sequential	45 (49%)	28 (57%)		
Age (y) (mean ± SD)	40±9	40±9	0.86	0.91
Anthropometric Measures (mean ± SD)				
Weight (kg)	96±16	95±18	0.83	0.90
Body Mass Index (kg/m²)	34±4	34±4	0.97	0.97
Waist Circumference (cm)	107±11	108±12	0.76	0.86
Gender (count (%))			0.62	0.83
Women	73 (80%)	41 (84%)		
Men	18 (20%)	8 (16%)		
Race (count (%))			**0.01** [a]	0.11 [a]
White	67 (74%)	41 (84%)		
Black or African American	19 (21%)	2 (4%)		
Other	5 (5%)	6 (12%)		
Ethnicity (count (%))			0.57	0.80
Hispanic or Latino	22 (24%)	14 (29%)		
Not Hispanic or Latino	69 (76%)	35 (71%)		

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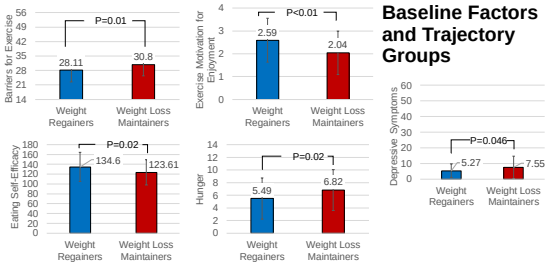
Baseline Factors and Trajectory Groups



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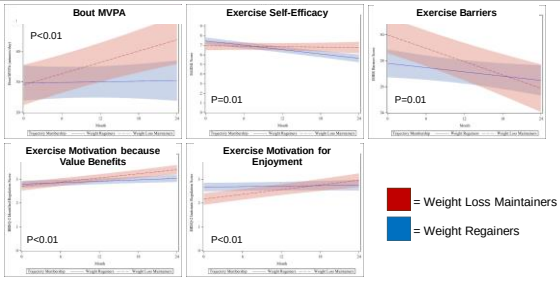

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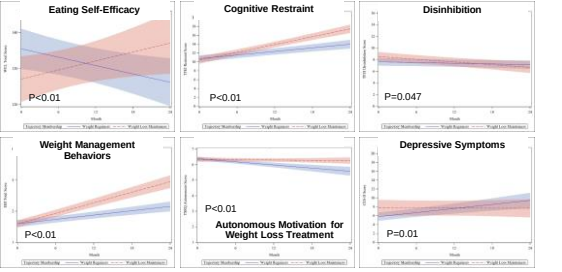

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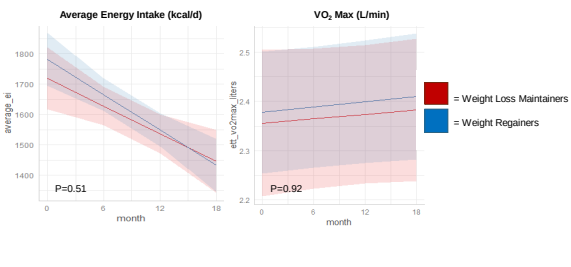

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Summary of Baseline Predictors of Trajectory Groups

Study Characteristic	Present Study	Batterham et al.	Morales et al.	Courcoulas et al.	
Sample Size	n=140	n=231	n=604	n=1738 RYGB	N=610 LAGB
Average Age	40±9 years	47±9 years	47±10 years	45 (37-54)	48 (37-56)
Gender	81% Female	75% Female	89% Female	80%	76%
Average BMI	34±4 kg/m^2	31±3 kg/m^2		37±6 kg/m^2	44 (40-48)
% Black	15%	Primarily Caucasian	100%	11%	8%

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Race: A Significant Predictor of Weight Loss/Weight Loss Maintenance

- Black participants (predominantly women) tend to lose less weight as compared to White participants
- Look AHEAD – weight loss at 1 year was significantly lower in Black (-6.8%) compared to non-Hispanic White participants (-9.6%)
  - But no racial/ethnic differences by year 4
- Black adults have higher rates of obesity and obesity-related comorbidities (diabetes, CVD)
- Potential biological, behavioral, and sociocultural factors

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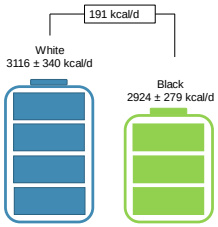
Racial Differences: Biological

- Delany and Colleagues: longitudinal changes in body weight and energy expenditure (DLW) during a 6-month weight loss intervention
- n=25 White and Black female matched pairs based on body weight; all severely obese

	White	Black
Weight loss	-11.7 ± 6.4 kg	-7.7 ± 4.7
Prescribed Energy Intake	1806 ± 153 kcal/d	1794 ± 153 kcal/d
Measured Energy Intake during intervention	2630 ± 442 kcal/d	2591 ± 371 kcal/d
Energy Requirement (TDEE)	3116 ± 340 kcal/d	2924 ± 279 kcal/d
Actual Energy Deficit	-485 ± 264 kcal/d	-333 ± 210 kcal/d
Change in Steps	1064 ± 3647 steps/d	1238 ± 850 steps/d



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DeLany et al. "African American women exhibit similar adherence to intervention but lose less weight due to lower energy requirements"; 2014; *International Journal of Obesity*

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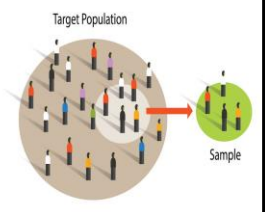
Racial Differences: Sociocultural

- Black participants achieved similar weight loss to White participants, when Black participants made up >50% of the total sample [1]
  - Natural alteration of group dynamics and interpersonal relationships
- What about cultural adaptions?
  - Some studies show enhanced weight loss and weight loss maintenance in Black participants [2-4]
  - Others show no additional impact [5]
- In the present study – 90% Black, 68% White, 61% Hispanic were classified as regainers…



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[1] Kinsey et al. 2021 *Ethn Health*; [2] Kong et al. 2014 *Obes Rev*; [3] Fitzgibbon et al. 2010 *Obesity*
[4] Tussing-Humphreys et al. 2013 *J Obes*; [5] Burton et al. "Systematic Review" 2017 *Am J Health Educ*

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Psychosocial Differences at Baseline

- Regainers started intervention with:
  - Lower perceived barriers for exercise
  - Higher intrinsic motivation for exercise (enjoyment)
  - Higher eating self-efficacy
  - Lower hunger
  - Lower depressive symptoms
- Did regainers over-estimate their confidence in ability to eat healthy foods? [1]
- Ceiling effect
- If replicated in larger samples – we may be able to identify individuals who may need alternative behavioral support or adjunctive therapies

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[1] McAuley et al. 2011 *Health Psychol*

https://unsplash.com/s/photos

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Importance of Physical Activity

- Maintainers demonstrated significantly greater increases in MVPA performed in bouts of at least 10 minutes compared to regainers
- High levels of PA (250-300 min/week) are critical for weight loss maintenance [1]
- Maintainers performed ~300 min/week of MVPA in bouts at 24 months
- Regainers performed 215 min/week of MVPA in bouts at 24 months

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[1] Donnelly et al. 2009 *Med Sci Sports Exerc*

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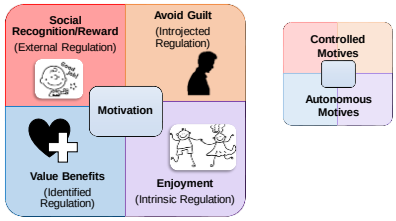
Motivation for Exercise: A Self-Determination Theory Perspective



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Deci and Ryan (1985) "Intrinsic motivation and self-determination in human behavior."

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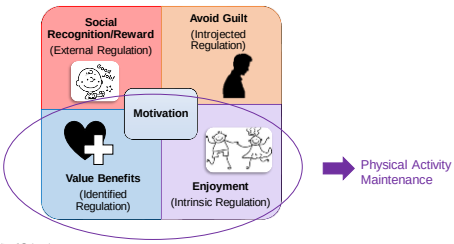
Autonomous Motivation Predicts Physical Activity Maintenance



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Teixeira et al. 2012 "Systematic Review" *Int J Behav Nutr Phys Activ*

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Motivation for Exercise

- Increases in autonomous motivation were associated with long-term weight loss maintenance
  - Valuing benefits from exercise
  - Enjoying exercise

Future Intervention Implications:

- Allow participants to choose their:
  - Physical activity type (walking, gardening etc.)
  - Location (more aesthetically pleasing settings like a hike in forest or along a beach)
  - Intensity (light vs. moderate vs. vigorous)
  - Duration
  - Make it fun!!

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Barriers for Exercise

- Decreases in barriers for exercise were associated with long-term weight loss maintenance
  - Time
  - Energy levels
  - Resources (distance to fitness center, park)
  - Social aspects (feelings of embarrassment, lack of social support)

Future Intervention Implications:

- Strategize with participants in how to fit activity into daily routine
- Start with light intensity for those new to exercise
- Create social support groups

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What about diet?

- The present study found no association with energy intake and weight trajectory group
- Zheng and colleagues[1] found that eating-related factors were associated with favorable weight loss trajectories:
  - Reductions in perceived barriers to healthy eating
  - Lower fat intake
- Limitations with self-reported energy intake – error and misreporting[2]

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[1] Zheng et al. 2017 *J Nurs Scholarsh*; [2] Dhurandhar 2015 *Int J Obes*

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Diet-related psychosocial factors

- Weight loss maintainers demonstrated significant improvements in
  - Eating self-efficacy
  - Cognitive restraint (tendency to consciously restrict food intake)
  - Disinhibition (tendency to overeat)
  - Engagement in weight management behaviors
- Eating self-efficacy is an important predictor of weight control behaviors (restricting energy intake)[1]
- Increases in cognitive restraint and reductions in disinhibition during a weight loss intervention are associated with long-term weight loss maintenance[2]

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[1] Ames et al. 2012 *Eat Behav;* [2] Elfhag et al 2005 *Obes Rev*

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Limitations

- Secondary, exploratory data analysis
- Small sample size – high variability within the 2 trajectory groups
- Sample is not generalizable (majority white women)
- Self-reported dietary intake data

Strengths

- 79% of participants provided at least 6 weights over 24 months
- Comprehensive examination of several biologic, behavioral, and psychosocial factors recommended by the Accumulating Data to Optimally Predict obesity Treatment (ADOPT) project
- Data-driven approach

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Implications for Future Research

- **Planned assessments and analyses of additional factors:**
  - **Biologic**:
    - Resting energy expenditure
    - Total daily energy expenditure (doubly labeled water)
    - Hormones related to appetite and hunger
  - **Behavioral**:
    - Sleep
  - **Psychosocial**
    - Stress
    - Personality
  - **Environment**
    - Perceptions of Crime
    - Walkability
    - Food Outlets

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Ongoing Obesity Research Trials at University of Colorado

Daily caloric Restriction vs. Intermittent Fasting (DRIFT-2) Weight Loss Trial (PI: Catenacci)

- n=165 adults with overweight or obesity randomized to daily caloric restriction or intermittent fasting
- All participants receive 12 months of behavioral support led by a registered dietitian
- Several biologic, behavioral, psychosocial, and environmental measures

Development of the *Move* Physical Activity Support Program (PI: Ostendorf)

- Based on Self-Determination Theory
- Designed to improve autonomous motivation for physical activity

TimEx Study (PI: Catenacci)

- Adults with overweight or obesity randomized to receive morning or evening exercise

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Implications for Future Interventions: Race matters, High levels of Physical Activity, Exercise Enjoyment, and Motivation

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Study Participants

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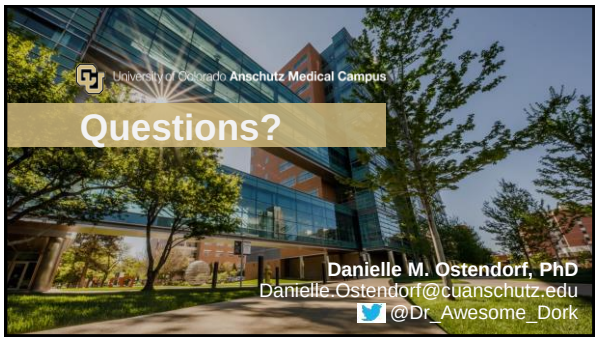

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Tackling Food Insecurity:
Bringing Data to Communities

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12-1 PM

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Eona Harrison, PhD
Senior Research Associate
The Urban Institute
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FEEDING THE NEED ↓ DEVELOPING SOLUTIONS

November, 2021 NEW! Small interactive webinar
Strategies for Reducing Weight Bias in Nursing Education: Strategies Towards Change
Tracy Oliver, PhD, RDN, LDN
Associate Professor, Villanova University M. Louise Fitzpatrick College of Nursing

December 15, 2021
Management of the Post-Bariatric Surgery Patient with Weight Regain
Nawfal Istfan, MD, PhD
Brigham and Women's Hospital Division of Endocrinology, Diabetes and Hypertension

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Q&A

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