
XXVIII IFSO World Congress
9-12 September 2025 | Santiago, Chile
Does Becoming Physically Active after Metabolic Bariatric Surgery Facilitate Positive Metabolic Phenotypic Transition?
Amir Ebadinejad, MD
Pavlos Papasavas, MD
Yin Wu, PhD
Lucas Carr, PhD
Raymond McKay, MD
Connie Santana Landry, MBA
Jeff Mather, MS
Darren Tishler MD
Dale Bond, PhD
IFSO 2025 Santiago
Combined Therapies, The Dawn of a New Era
ifso2025.org

Disclosure Slide

X	No, nothing to disclose
	Yes, please specify:

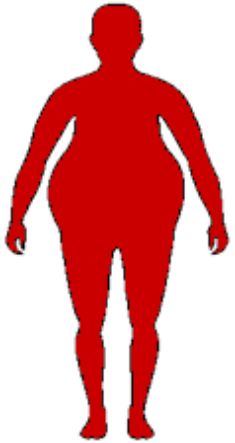
Company Name	*Honoraria/ Expenses*	*Consulting/ Advisory Board*	*Funded Research*	*Royalties/ Patent*	*Stock Options*	*Ownership / Equity Position*	*Employee*	*Other (please specify)*
Example: company XYZ	x		x		x			

Background (1)

- Obesity is a heterogenous disease—individuals living with obesity can vary in cardiometabolic risk factors and susceptibility to developing CVDs
- Individuals with the **MHO** phenotype have excess adiposity, but do not have the same indicators of cardiometabolic disease as those with the **MUO** phenotype.

Metabolically Healthy Obesity (MHO)

- Subcutaneous fat > liver & visceral fat
- Normal insulin sensitivity
- Normal glycemia
- Normal plasma lipid profile
- Normal blood pressure
- Lower levels of inflammatory markers
- Low-to-mild cardiovascular risk



Metabolically Unhealthy Obesity (MUO)

- Subcutaneous fat < liver & visceral fat
- Insulin resistance
- Prediabetes/type 2 diabetes
- Atherogenic dyslipidemia
- Increased blood pressure
- Higher levels of inflammatory markers
- Moderate-to-high cardiovascular risk

Bluher, et al. *Endocri Rev* 2020; Eckel, et al. *Lancet Diabetes Endocrinol* 2018; Guo, et al. *Obesity* 2016; Makdos. *Am J Clin Nutr* 2019; Mongrow-Chaffin, et al. *J Am Coll Cardiol* 2018; Tsatsouli, et al. *Curr Obes Rep* 2020; Vasan, et al. *Nat Rev Endocrinol* 2016

Background (2)

XXVIII IFSO World Congress
9-12 September 2025
Santiago, Chile

- **Improving understanding of the MHO/MUO phenotypes in the context of MBS is important**
  - Elucidating variability in MBS outcomes
  - MBS to stimulate transition from **MUO** to **MHO**
- **Research on the MHO phenotype in MBS is still in its infancy**
  - Only a minority of pts (9%-37%) have MHO before MBS
  - Large variability in **MUO→MHO** transition after MBS, with rates ranging from 37%-89%
- **Limited understanding of variability and why some patients with MUO before MBS do not transition to MHO after MBS**

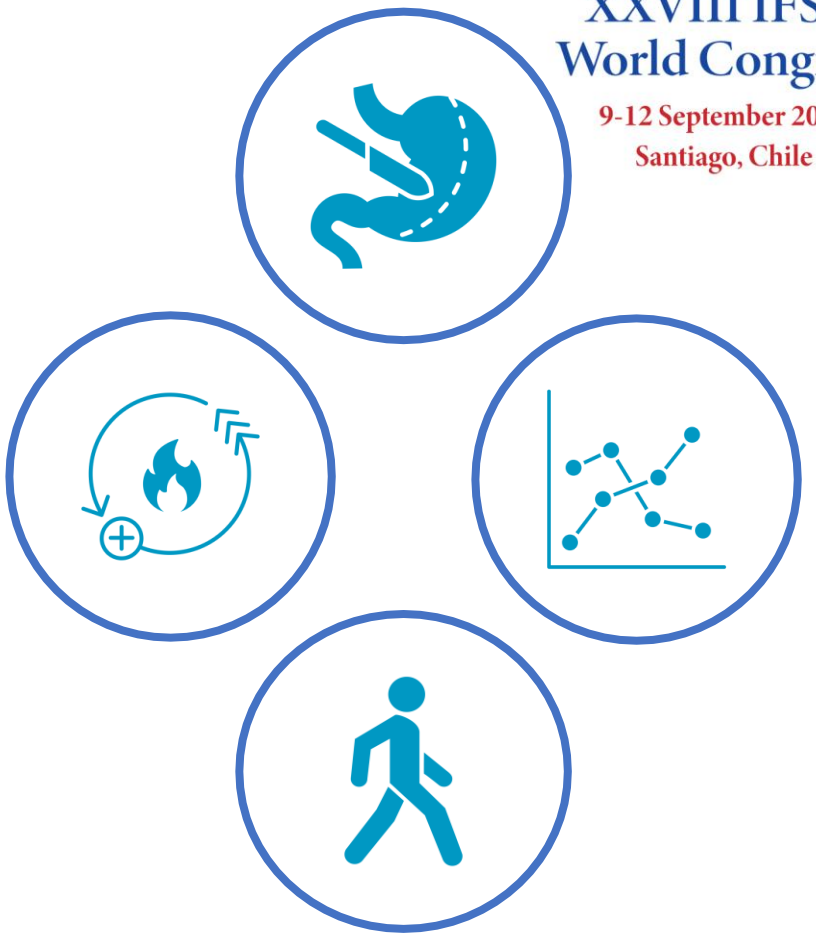
Catoi, et al. *Obes Surg* 2019; Genua, et al. *Obes Surg* 2021; Goday, et al. *Surg Obes Relat Dis* 2021; Heidari Almasi, et al. *World J Surg* 2023; Luna, et al., *Metabolites* 2024; Mendonca, et al. *Int J Obes* 2024; Nie, et al. *Diabetol Metab Syndr* 2024; Oh, et al. *PLoS One* 2023

Background (3)

- **One factor that may help explain variability in MUO/MHO in MBS field is physical activity (PA)**

- **However, study has examined the role of PA in facilitating MUO→MHO transition after MBS, despite:**

  - PA being a key modulator of cardiometabolic health (even in the presence of obesity)
  - MHO having higher moderate-to-vigorous intensity PA (MVPA) and fitness levels, as well as lower sedentary time
  - Some studies suggesting that PA and exercise contribute to improvements in cardiometabolic risk factors after MBS



Bellicha, et al. *Obes Rev* 2021; Boppre, et al. *Obes Surg* 2022; Ortega, et al. *Prog Cardiovasc Dis* 2018; Wefers, et al. *Surg Obes Relat Dis* 2017

Aims/Hypotheses (1)

AIM 1

- To examine whether PA status is associated with increased odds of having **MUO** before MBS

- Hypothesis: Participants who were insufficiently active would have an increased likelihood of having **MUO** compared to those who were sufficiently active.

Aims/Hypotheses (2)

AIM 2

- To examine whether change in PA status after MBS is associated with **MUO** → **MHO** transition

- Hypothesis: **MUO** who became sufficiently active after MBS would have a higher likelihood of transitioning to **MHO** than those who remained insufficiently active

Methods (1)

XXVIII IFSO World Congress
9-12 September 2025
Santiago, Chile

Participants

- Underwent MBS between August 2022 and June 2024
- ≥18 years old
- Pre-MBS BMI ≥ 35 kg/m^2
- Sufficient data for classifying metabolic obesity phenotype & PA status at pre-MBS (Aim 1)
- Reached 6-months post-MBS and had sufficient data for classifying metabolic obesity phenotype & PA status at pre-and post-MBS (Aim 2)

Methods (2)

Classification of Metabolic Phenotypes

MUO and **MHO** classified based on National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) criteria

1. High blood pressure (BP): Systolic BP ≥130 mmHg or Diastolic BP ≥85 mmHg or related pharmacotherapy (Rx)
2. High triglycerides (TG): ≥150 mg/dL or Rx
3. Low high-density lipoprotein cholesterol (HDL): 40 mg/dL & 50 mg/dL in men and women, respectively or Rx
4. High fasting plasma glucose (FPG): ≥100 mg/dL or Rx

Met ≥ 2 =

Met < 2 =

National Cholesterol Education Program (NCEP): Expert Panel on Detection and Treatment of High Blood Cholesterol in Adults. *Circulation* 2002; American Diabetes Association. *Diabetes Care* 2010; Blüher, et al., *Endocr Rev* 2020; Stefan, et al. *Lancet Diabetes Endocrinol* 2013, 2018

Methods (3)

Classification of PA Status

- PA status based on responses to validated *Exercise Vital Sign* inactivity screener
  - Participants report on:
    1. Average # of days/week that MVPA (like a brisk walk) is performed
    2. Average # if minutes/day exercise is performed at this level
  - Response 1 x Response 2 = Average MVPA minutes/week

<150 MVPA minutes/week	≥150 MVPA minutes/week
	
INSUFFICIENTLY ACTIVE	**SUFFICIENTLY ACTIVE**

Chapman, et al. *Prev Chronic Dis* 2025; Coleman, et al. *Med Sci Sports Exerc* 2012; Kuntz, et al. *Am J Prev Med* 2022; Sallis, et al. *Phys Sportsmed* 2015; Young, et al. *Prev Chronic Dis* 2014

Methods (4)

Analytic Strategy

AIM 1
• To examine whether being insufficiently active is associated with increased odds of having **MUO** **before** surgery
• Pre-MBS participants with metabolic and PA data
• **Multiple logistic regression to examine odds of having MUO based on PA status (insufficiently active vs. sufficiently active).**

Methods (5)

Analytic Strategy (cont.)

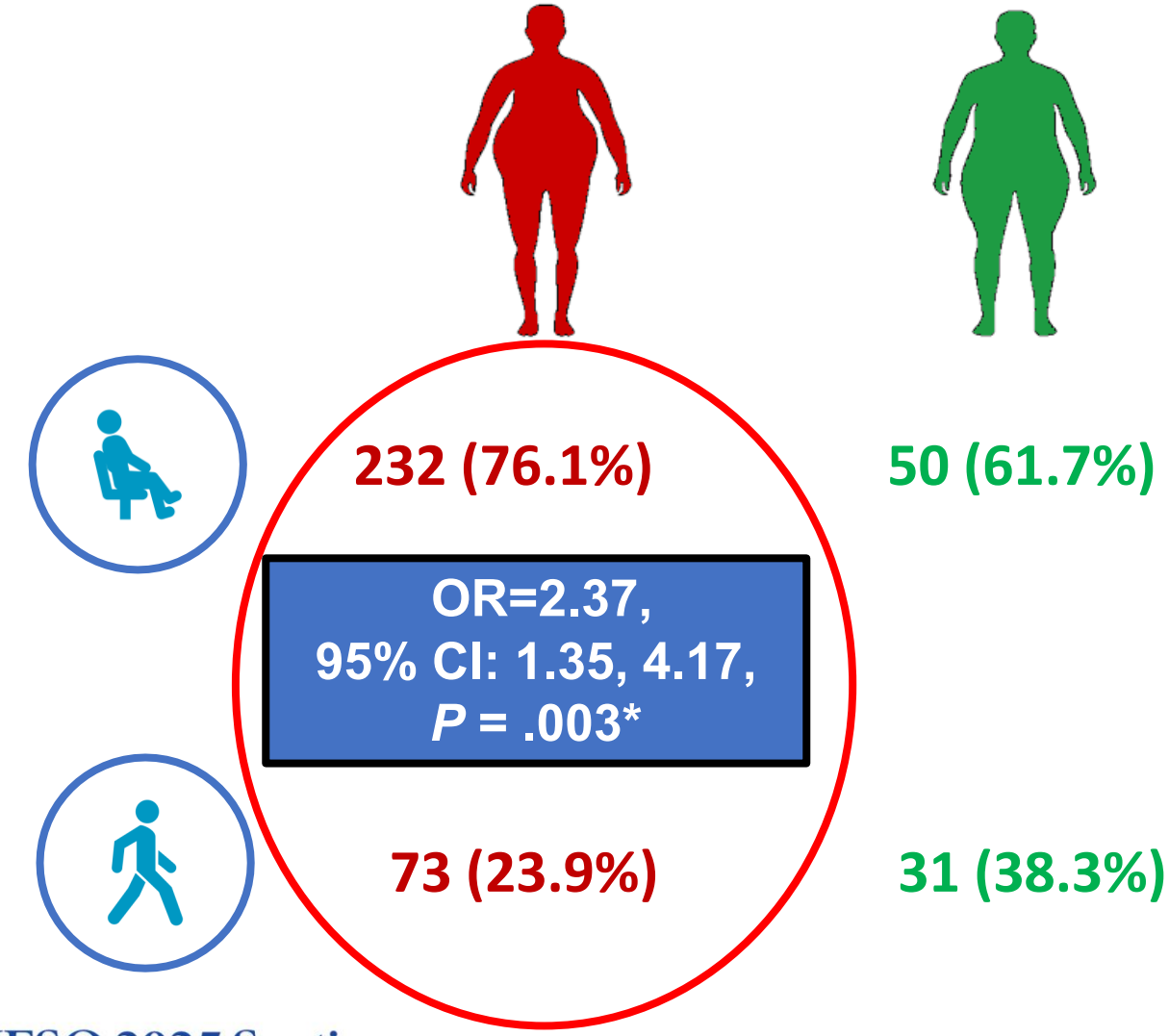
AIM 2
• To examine whether becoming sufficiently active after MBS is associated with **MUO** → **MHO** transition
• Participants who were **MUO** + insufficiently active at pre-MBS, reached 6-months post-MBS, & had metabolic and PA data at both time points
• **Multiple logistic regression examined odds of MUO → MHO transition in participants who became sufficiently active vs. those who remained insufficiently active**

Results: Aim 1

Participant characteristics by MHO/MUO status at pre-MBS

	Total (N=386)	MHO (N=81, 21%)	MUO (N=305, 79%)	*P*-value
Age, yrs, mean ± SD	41.9 ± 11.3	36.0 ± 9.4	43.4 ± 11.3	**<.001**
Sex, female, n (%)	328 (85.0%)	76 (93.8%)	252 (82.6%)	**.012**
Race, Non-White, n (%)	215 (55.7%)	47 (58%)	168 (55.1%)	.636
Ethnicity, Hispanic/Latino, n (%)	142 (36.8%)	30 (37.0%)	112 (36.7%)	.958
BMI, kg/m^2, mean ± SD	43.7 ± 6.9	42.7 ± 5.9	43.9 ± 7.1	.247
Smoker (within past yr), n (%)	24 (6.2%)	1 (1.2%)	23 (7.5%)	**.037**

Results: Aim 1



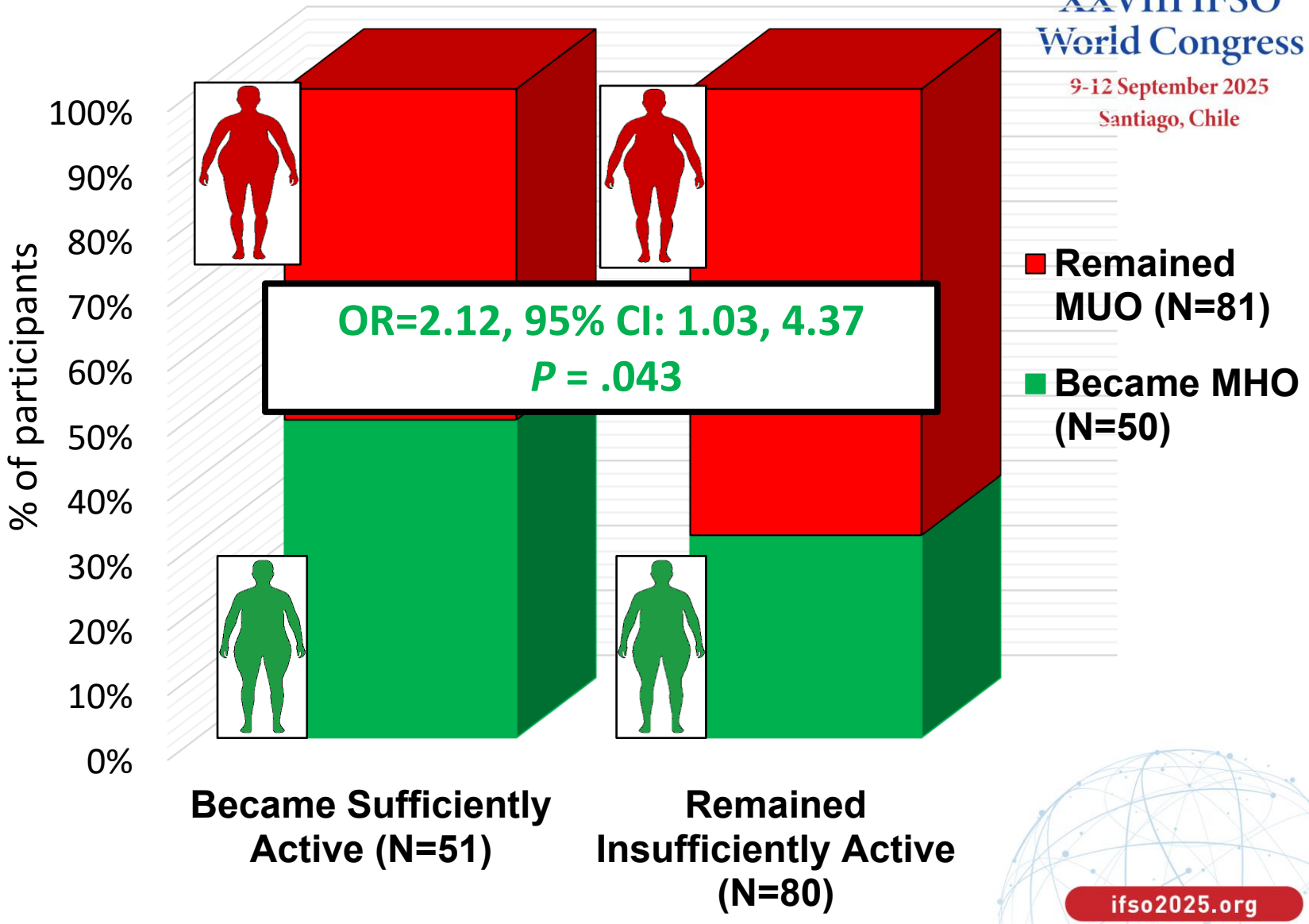
Patients who were insufficiently active had a 137% higher likelihood of having MUO vs. those who were sufficiently active

* Controlling for age, sex, and smoking status

Results: Aim 2

Of 232 patients with pre- and post-MBS data, 131 (56%) had MUO and were insufficiently active pre-MBS

Participants who became active had a 112% higher likelihood of transitioning from MUO to MHO vs. those who remained insufficiently active



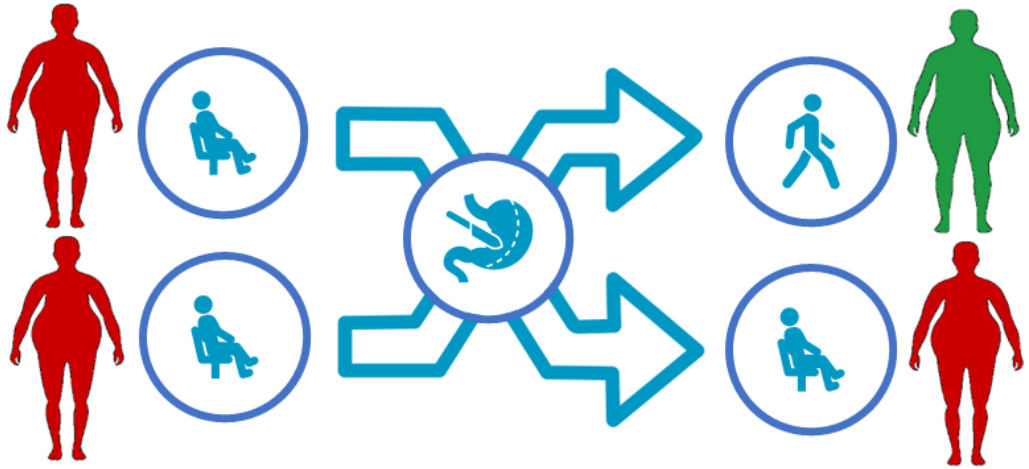
Discussion (1)

XXVIII IFSO World Congress
9-12 September 2025
Santiago, Chile

Key Findings

- **Pre-MBS**
  - 79% of patients had **MUO**
  - Pts who were insufficiently active had a >2-fold higher likelihood of having **MUO** vs. those who were sufficiently active.

- **Pre- to 6-months post-MBS**
  - 38% of pts with **MUO** pre-MBS transitioned to **MHO** post-MBS
  - Pts who went from insufficiently active to sufficiently active had a >2-fold higher likelihood of transitioning from **MUO** to **MHO** vs. those who remained insufficiently active.



Discussion (2)

XXVIII IFSO World Congress
9-12 September 2025
Santiago, Chile

STRENGTHS

- First study to examine relationship between PA status and metabolic phenotypic transition in the context of MBS
- Prospective design
- Use of validated inactivity screener and criteria for classifying **MUO**/**MHO**

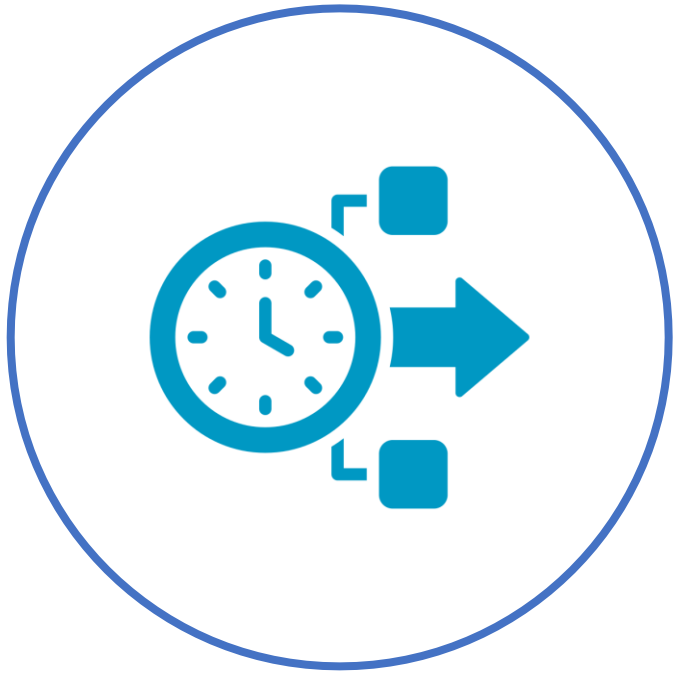
LIMITATIONS

- Self-reported PA
- Did not measure dietary intake
- Limited follow-up

Discussion (3)

Future Directions

- Additional research is needed to:
  - confirm findings with device-measured PA & explore role of other movement behaviors
  - examine whether relationships persist over time & if PA can sustain positive phenotypic transition despite weight recurrence.
  - develop and test adjunctive pre- and post-MBS PA interventions to help patients with **MUO** become **MHO**



Acknowledgements

Hartford HealthCare
Digestive Health Institute

IFSO 2025 Santiago
Combined Therapies, The Dawn of a New Era

XXVIII IFSO World Congress
9-12 September 2025
Santiago, Chile

Amir Ebadinejad, MD

Pavlos Papasavas MD

Yin Wu, PhD

Lucas Carr, PhD

Raymond McKay, MD

Connie Santana Landry, MBA

Jeff Mather, M.S.

Darren Tishler, MD

ifso2025.org