UNIVERSIDAD SAN SEBASTIAN
VOCACIÓN POR LA EXCELENCIA
35 años 1989-2024

Exercise intensity-dependent metabolic benefits in muscle, adipose tissue, and liver of candidates to undergo bariatric surgery

Sergio Martínez Huenchullán[1,2,3], Javier Enríquez Schmidt[3,4], Camila Mautner Molina[5], Mariana Kalazich Rosales[5], Maximiliano Muñoz[1,5], Matías Ruiz-Uribe[6], Francisca Fuentes Leal[5], Manuel Monrroy Uarac[3,4], Carlos Cárcamo Ibaceta[5,7], Pamela Ehrenfeld[8]

[1] School of Physical Therapy, Universidad San Sebastián, Valdivia, Chile
[2] Exercise Sciences and Health Laboratory, Universidad San Sebastián, Valdivia, Chile
[3] Physiotherapy Unit, Locomotor Apparatus and Rehabilitation Institute, Faculty of Medicine, Universidad Austral de Chile, Valdivia, Chile
[4] Exercise Physiology Laboratory, Faculty of Medicine, Universidad Austral de Chile, Valdivia, Chile
[5] Clínica Alemana de Valdivia, Valdivia, Chile
[6] Nephrology Division, School of Medicine, Universidad Austral de Chile, Valdivia, Chile
[7] Surgery Institute, Faculty of Medicine, Universidad Austral de Chile, Valdivia, Chile
[8] Cellular Pathology Laboratory, Anatomy, Histology, and Pathology Institute, Faculty of Medicine, Universidad Austral de Chile, Valdivia, Chile.

SEDE VALDIVIA

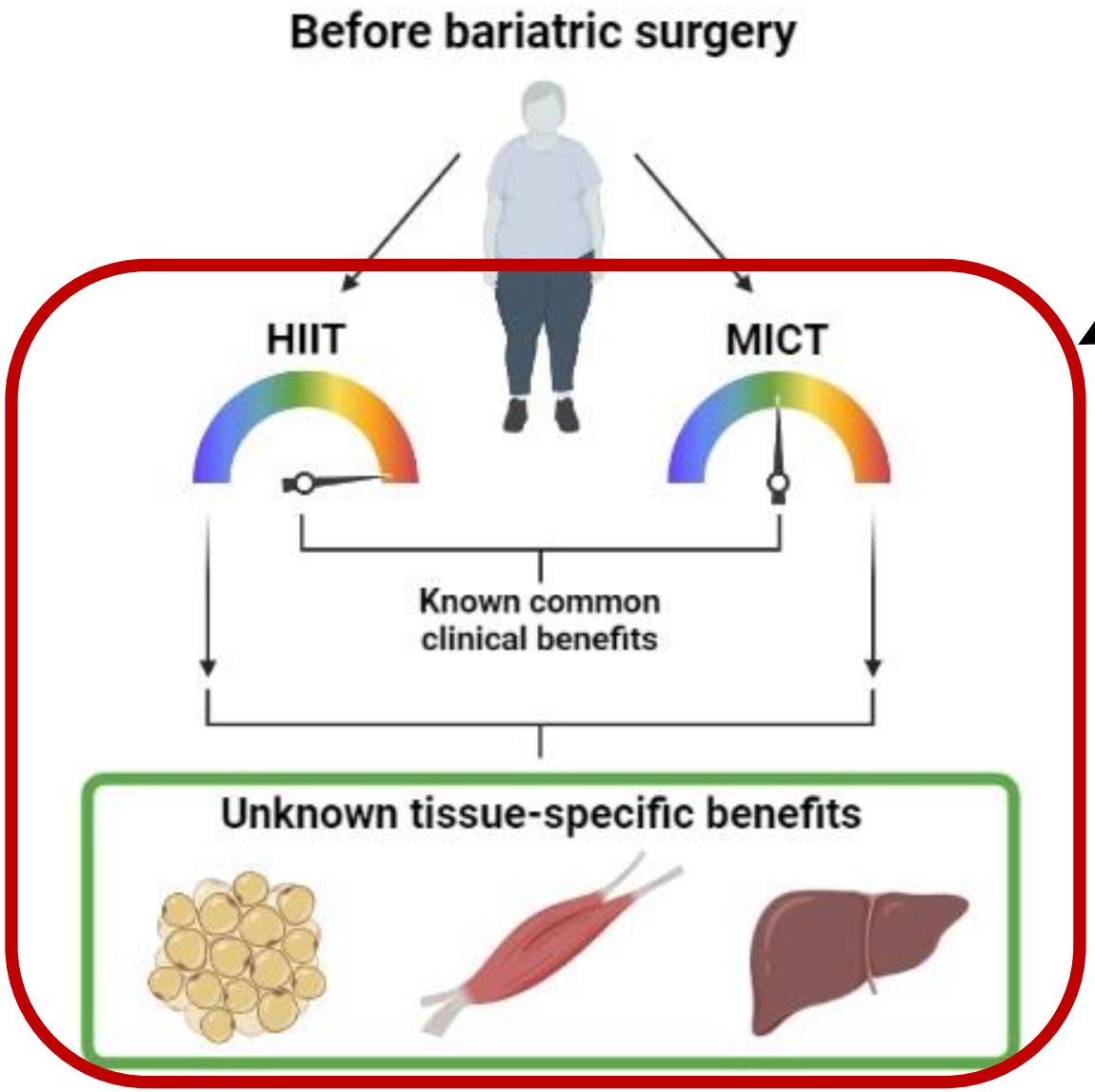
Introduction

Obesity

High national, regional, and worldwide prevalency

Bariatric Surgery

Physical and metabolical preparation of the candidate



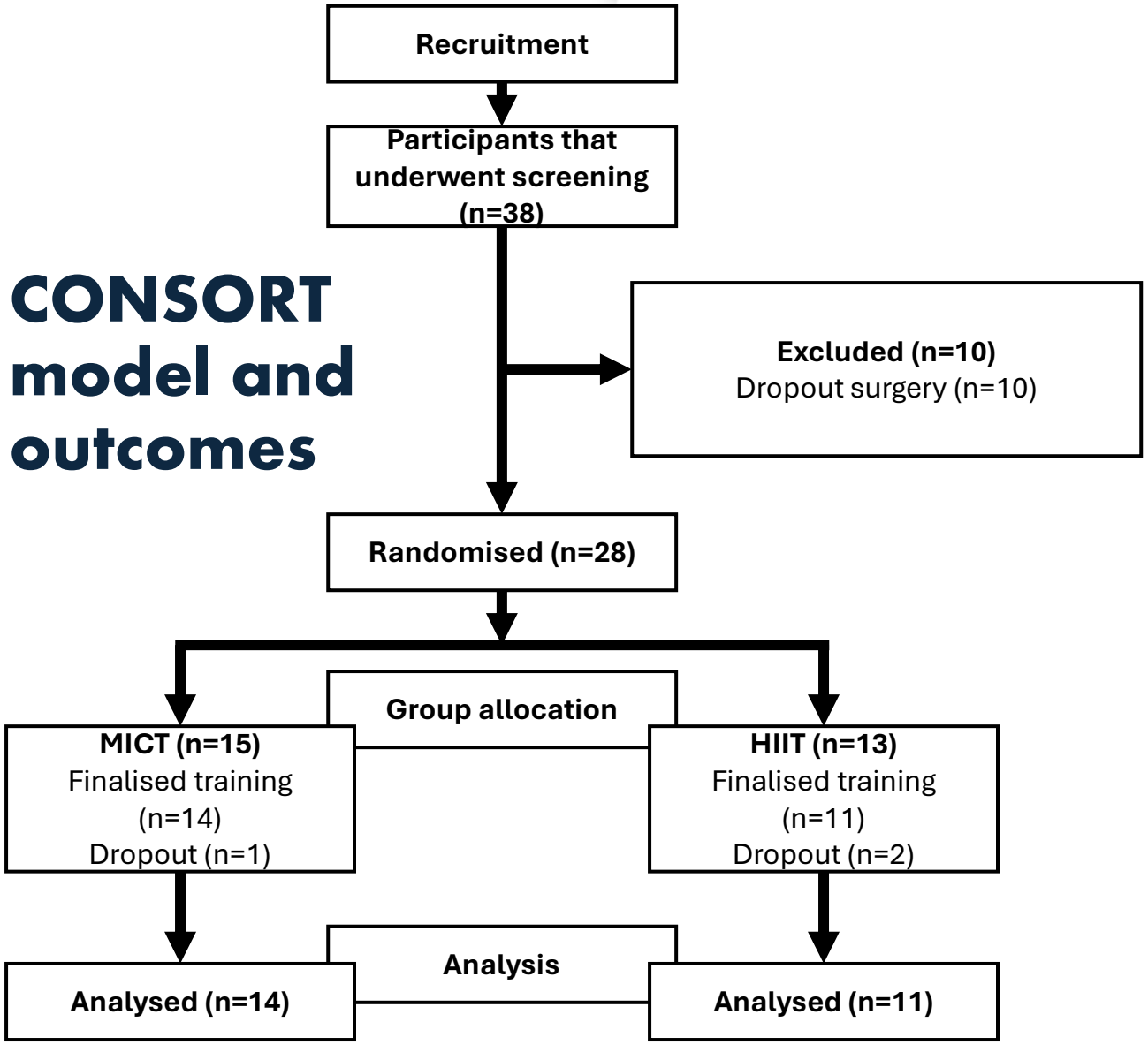
Major challenge in finding a precise exercise prescription

Martinez-Huenchullan S, Kalazich-Rosales M, Mautner-Molina C, Fuentes Leal F, Cárcamo-Ibaceta C, Tam C, Ehrenfeld P. Physiological relevance of aerobic exercise training for the preparation of bariatric surgery candidates. Physiological Mini Reviews. 2021;14(3):20-33.

Aim

To compare the physical and metabolic effects of Moderate-Intensity Constant Training (MICT) and High-Intensity Interval Training (HIIT) on the phenotype and metabolic function of candidates to undergo bariatric surgery

CONSORT model and outcomes



Phenotype

- **Anthropometry**
  - Bioimpedance (InBody® 270)
  - Measurements (dietitian)
- **Spontaneous physical activity**
  - IPAQ short-form
- **Grip strength**
  - Dinamometry (Jamar®)
- **Aerobic capacity**
  - Modified Bruce's protocol

Metabolic function

- **Lipid profile**
  - Cholesterol (total and lipoproteins)
- **Renal function markers**
  - Creatinine, BUN, urea
- **Transaminases**
  - GOT, GPT
- **Glucose metabolism**
  - Fasting and OGTT (2 hours)
- **Circulatory and tissue proteins**
  - Western Blot and ELISA

Inclusion Criteria

- Between 18 to 60 years old
- Sleeve gastrectomy

Exclusion Criteria

- Could not attend exercise sessions
- Medical contraindication to perform physical activity
- Functional limitation that don't allow the participant to complete a submaximal cardiorespiratory test
- Uncontrolled neuropsychiatric illnesses

This study was reviewed and approved by the Valdivia Health Service Scientific Ethics Committee (Code 350/2020)

International Traditional Medicine Clinical Trial Registry (N° ISRCTN42273422)

4 weeks (2-3 sessions/week)

Baseline measurements

Phenotype
Metabolic function

MICT: 30 min at 50% HRR
HIIT: 6 cycles of 2.5 min at 80% HRR and 6 active rest periods of 2.5 min at 20% HRR

30 min of common strengthning exercises

Post-training measurements
Tissue samples (muscle, liver, adipose tissue)
Phenotype
Metabolic function

UNIVERSIDAD SAN SEBASTIAN
VOCACIÓN POR LA EXCELENCIA
35 años 1989-2024

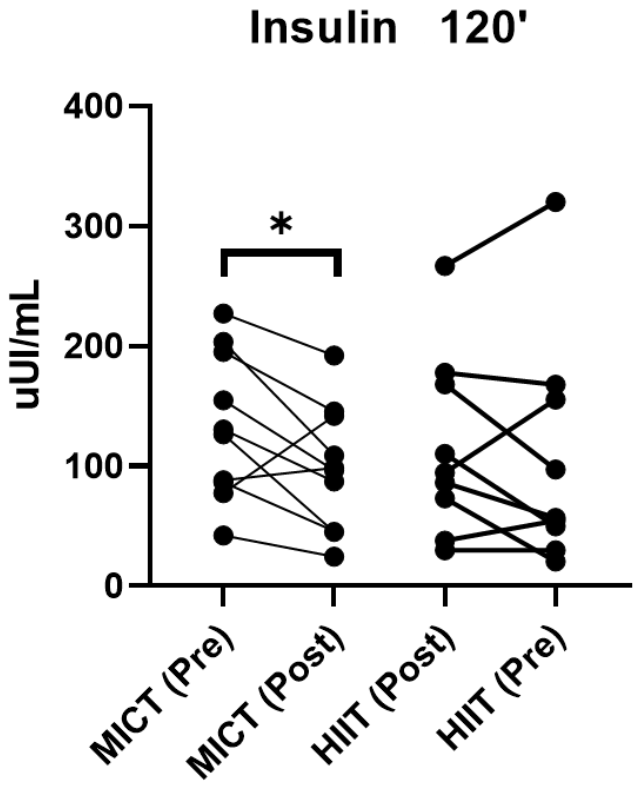
Phenotype

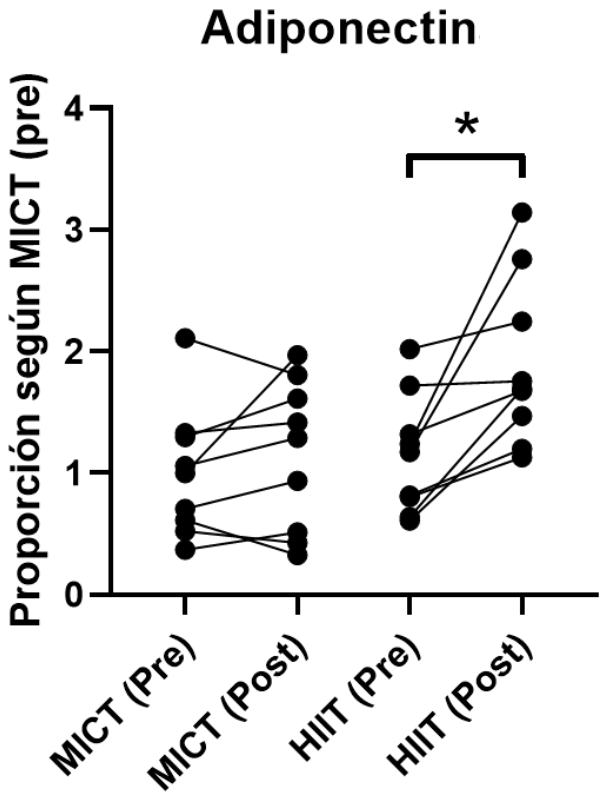
Results

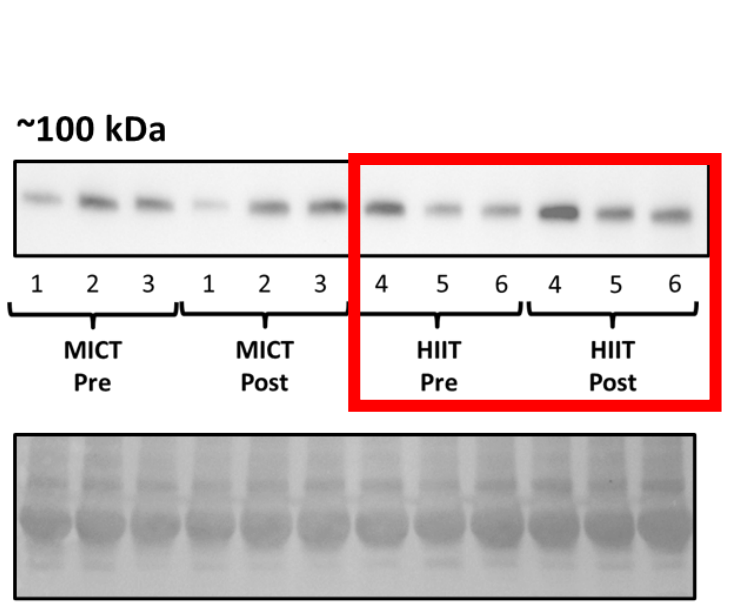
Significant effect (p<0.05) from:
MICT:
HIIT:
Both:

Parameter	Pre-MICT	Post-MICT	Pre-HIIT	Post-HIIT
Sex (M/F)	2/12	--	1/10	
Age (años)	38,9 ± 7,7		33,0 ± 7,2	
Height (m)	1,63 ± 0,8		1,64 ± 0,7	
Weight (kg)	**107 ± 21**	**103 ± 18**	112 ± 17	108 ± 17
BMI (kg/m^2)	**41,0 ± 5,3**	**38 ± 4,1**	41,9 ± 6,9	40,5 ± 7,2
Total fat mass (%)	**48,9 ± 3,2**	**47,4 ± 3,5**	47,7 ± 6,0	48,6 ± 4,3
Total muscle mass (%)	**28,5 ± 1,8**	**29,3 ± 2,1**	28,6 ± 2,7	30,6 ± 6,4
Waist circumference (cm)	**119 ± 15**	**115 ± 16**	**124 ± 16**	**116 ± 15**
Hip circumference (cm)	**125 ± 8**	**121 ± 7**	**129 ± 9**	**126 ± 10**
Waist-to-hip ratio	0,95 ± 0,08	0,95 ± 0,1	0,95 ± 0,09	0,91 ± 0,07
Waist-to-height ratio	0,73 ± 0,08	0,65 ± 0,2	0,75 ± 0,1	0,72 ± 0,1
Aerobic capacity (m)	**639 ± 177**	**730 ± 193**	**646 ± 197**	**754 ± 135**
Spontaneous physical activity (MET*min*week)	**1235 ± 1125**	**2287 ± 1495**	993 ± 867	1798 ± 1139
Sitting hours (n)	**6,2 ± 3**	**4,9 ± 2,2**	6,1 ± 3	5,3 ± 2,7
Grip strength (kg)	33 ± 7,8	33 ± 7,7	31 ± 5,4	30 ± 4,8

Results (circulatory)

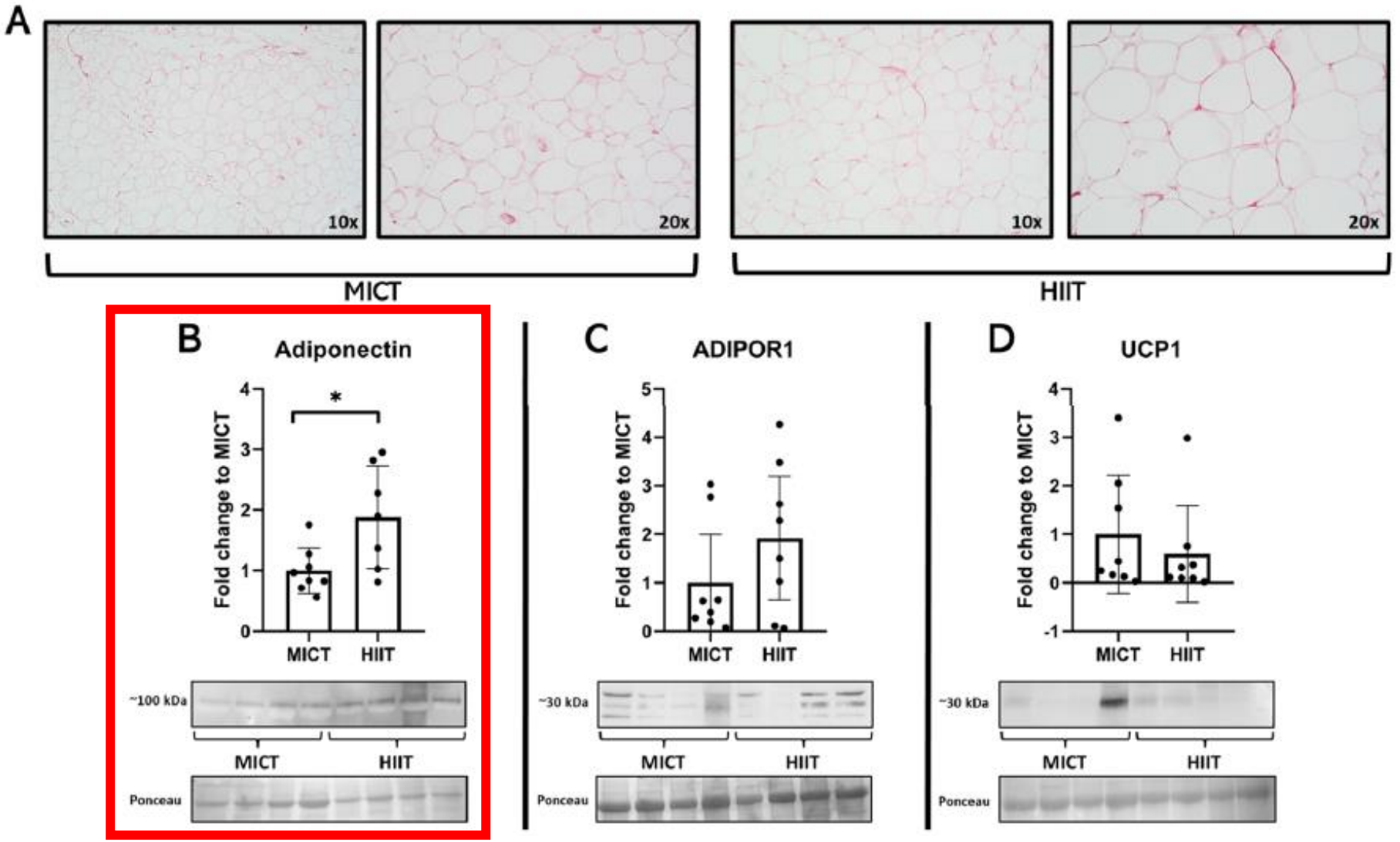






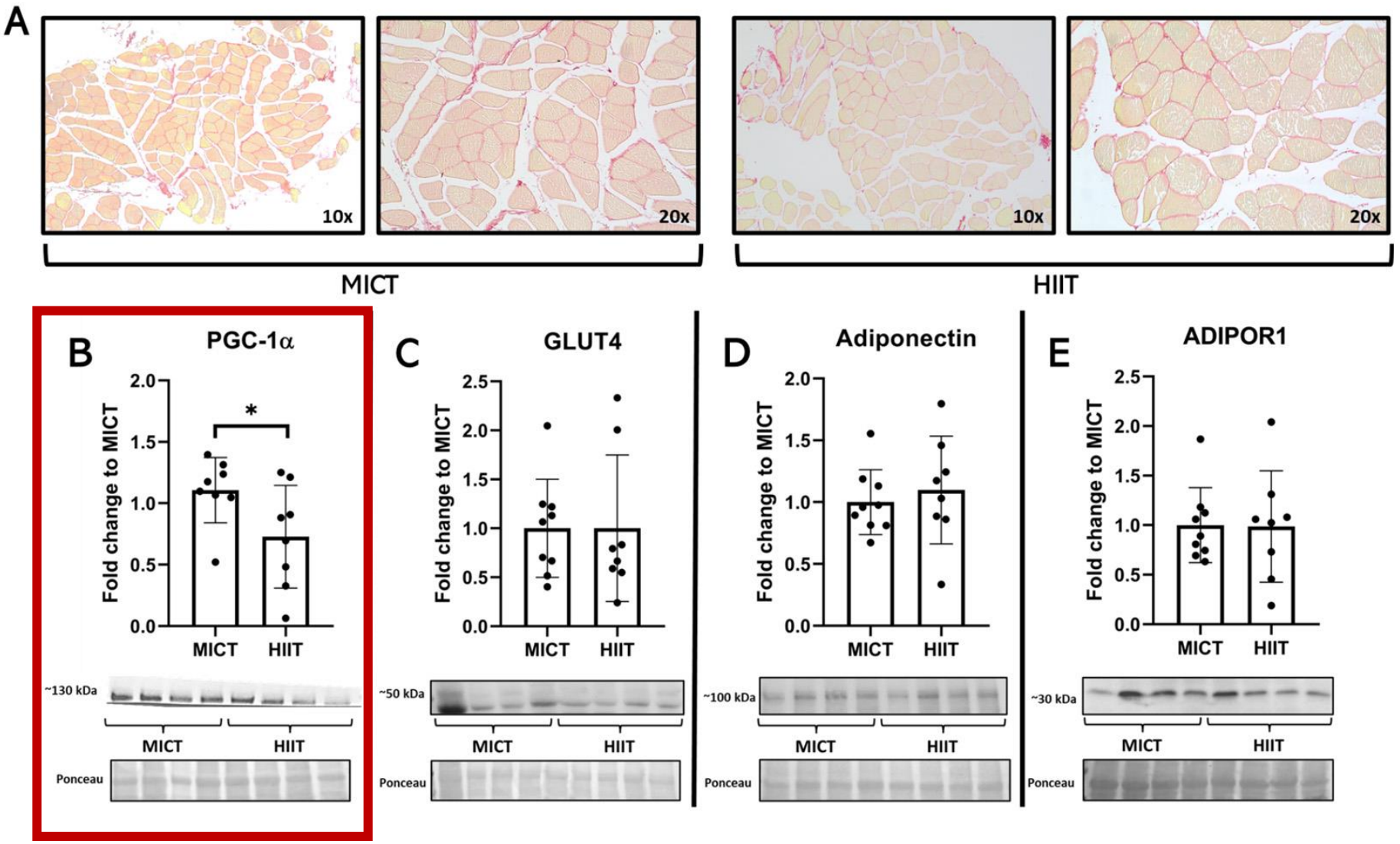
Results from circulatory proteins suggest tissue-dependent effects of exercise depending on its intensity

White adipose tissue



Higher adiponectin after HIIT are tighly associated with what was measured in plasma

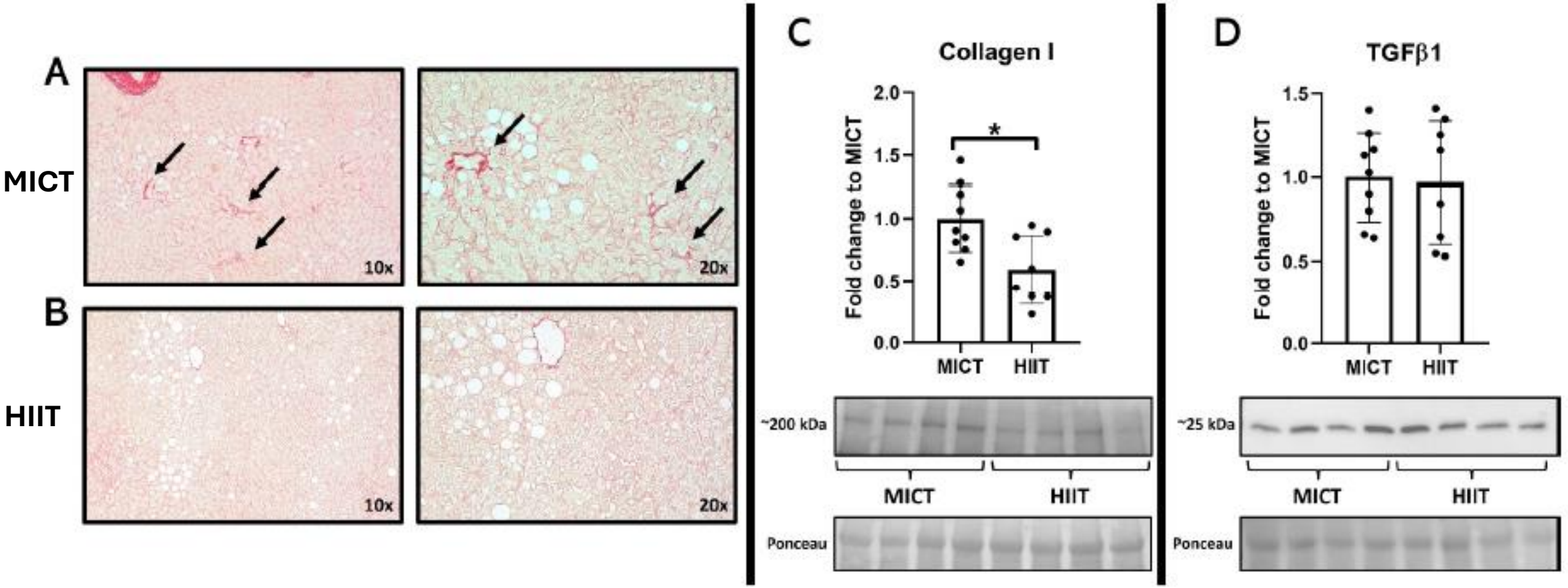
Skeletal muscle (*transversus abdominis*)



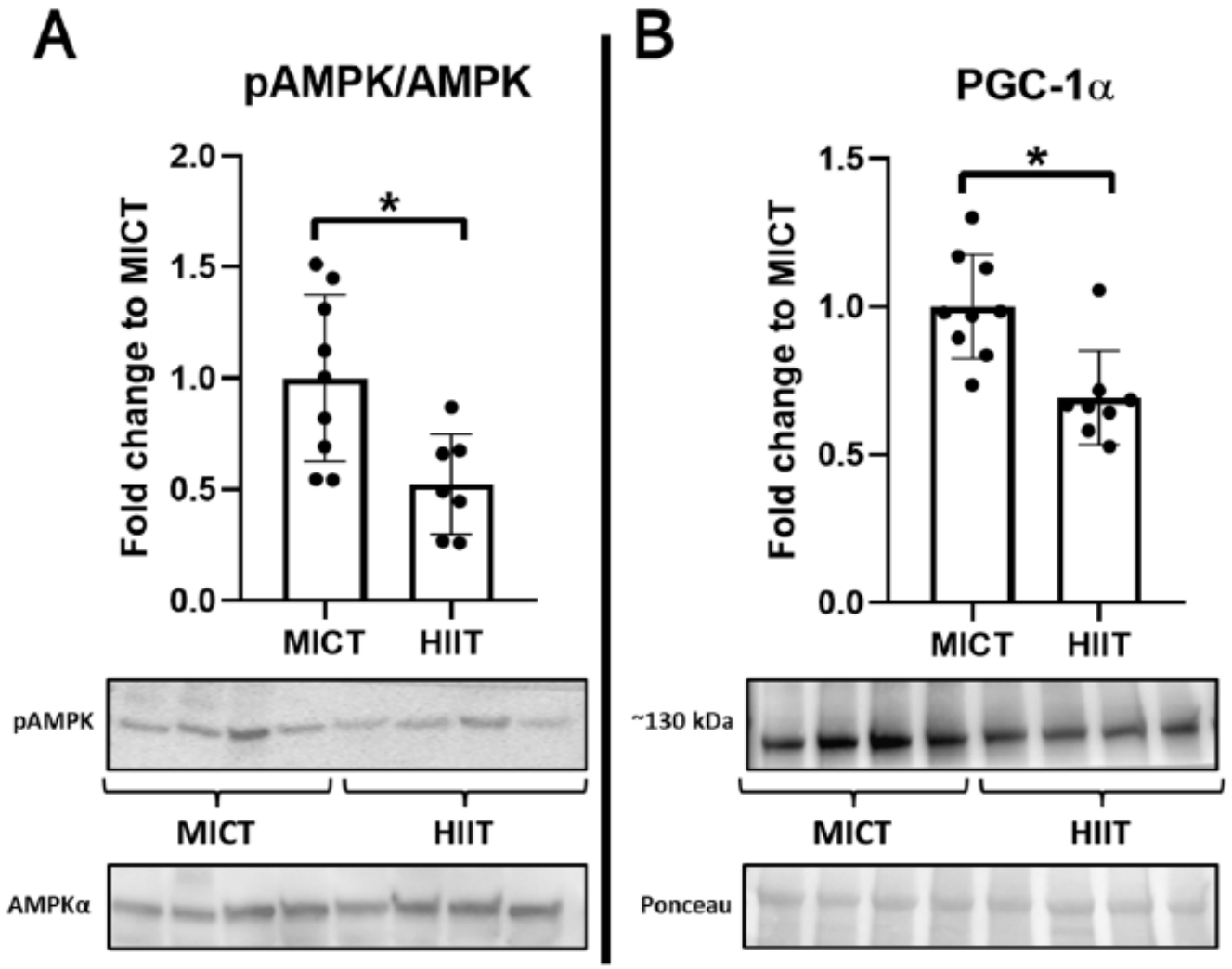
Higher insulin sensitivity after MICT, which is associated with higher levels of PGC-1a in skeletal muscle

Liver (1)

Arrows: fibrotic sites



Liver (2)



Conflicting results could suggest that HIIT ameliorates metabolic alterations, which results in a lower metabolic burden

Conclusions

- **Both MICT and HIIT conferred phenotypical and metabolic benefits in candidates to undergo bariatric surgery**
  - **Exercise must be included in the preparation programs for these candidates**

- **MICT and HIIT conferred differential metabolic benefits**
  - **Exercise should be prescribed depending on the metabolic dysfunctions present in our users (no recipies)**

Acknowledgements

- **Funding**
  - ANID FONDECYT iniciación (Project N° 11200391)
  - This presentation was partially funded by Vicerrectoría de Investigación y Doctorados of Universidad San Sebastián, Chile (USS-FIN-24-CNGI-34)
  - Travel grant: Chilean Society of Bariatric and Metabolic Surgery
- **Technical support**
  - Exercise Physiology Laboratory, Universidad Austral de Chile
  - Nephrology Laboratory, Universidad Austral de Chile

Agencia Nacional de Investigación y Desarrollo
Ministerio de Ciencia, Tecnología, Conocimiento e Innovación
Gobierno de Chile
Concurso Proyectos FONDECYT INICIACIÓN EN INVESTIGACIÓN 2020

Project N° 11200391

SCCBM Sociedad Chilena de Cirugía Bariátrica y Metabólica

UNIVERSIDAD SAN SEBASTIAN

VOCACIÓN POR LA EXCELENCIA

35 años 1989-2024

Santiago | Concepción | Valdivia | Puerto Montt

www.uss.cl

UNIVERSIDAD SAN SEBASTIAN
VOCACIÓN POR LA EXCELENCIA
35 años 1989-2024

Metabolic function

Results

Significant effect (p<0.05) from:
MICT:
HIIT:
Both:

Parameter	Pre-MICT	Post-MICT	Pre-HIIT	Post-HIIT
Cholesterol (mg/dL)	176 ± 22	172 ± 24	188 ± 45	189 ± 50
Triglycerides (mg/dL)	113 ± 50	121 ± 63	143 ± 107	135 ± 82
HDL (mg/dL)	42 ± 10	41 ± 11	43 ± 10	46 ± 10
LDL (mg/dL)	111 ± 22	106 ± 26	120 ± 37	119 ± 38
VLDL (mg/dL)	23 ± 10	24 ± 12	28 ± 21	27 ± 16
No-HDL (mg/dL)	133 ± 23	130 ± 22	144 ± 45	143 ± 47
Albumin (g/dL)	4,2 ± 0,2	4,2 ± 0,1	4,3 ± 0,2	4,3 ± 0,2
Ureic acid (mg/dL)	4,9 ± 1,3	4,9 ± 1,3	4,8 ± 1,4	4,5 ± 0,9
Creatinine (mg/dL)	**0,75 ± 0,11**	**0,82 ± 0,14**	0,77 ± 0,10	0,76 ± 0,13
Urea (mg/dL)	**27 ± 8**	**34 ± 10**	27 ± 7	25 ± 6
BUN (mg/dL)	**13 ± 3**	**16 ± 5**	12 ± 3	12 ± 2
GOT (UI/L)	21 ± 6	28 ± 29	45 ± 70	28 ± 22
GPT (UI/L)	29 ± 13	44 ± 44	55 ± 66	40 ± 32
Glycaemia (mg/dL)	97 ± 11	98 ± 11	95 ± 12	95 ± 11
Insulin (µUI/mL)	21 ± 7	20 ± 12	20 ± 9	20 ± 8
HOMA-IR	5,1 ± 1,8	5,1 ± 3,7	4,9 ± 2,5	4,7 ± 2,1
HbA1c (%)	5,7 ± 0,7	5,5 ± 0,6	**5,6 ± 0,5**	**5,4 ± 0,3**
Glycaemia post-OGTT	126 ± 59	128 ± 50	121 ± 53	115 ± 28
TSH (µUI/mL)	3,6 ± 4,7	6,1 ± 12	6,2 ± 13	3,1 ± 2,9