

Physical activity as an ecological key to healthy aging - outdoor activities or in the gymnasium.

Opole June 2025

PhD ALEJANDRO GALÁN MERCANT

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University of Cádiz, South Spain.



Funded by
the European Union



“Human Beings and CNS' essence is MOVEMENT”

Daniel Wolpert

Basic Functional



Complex Functional



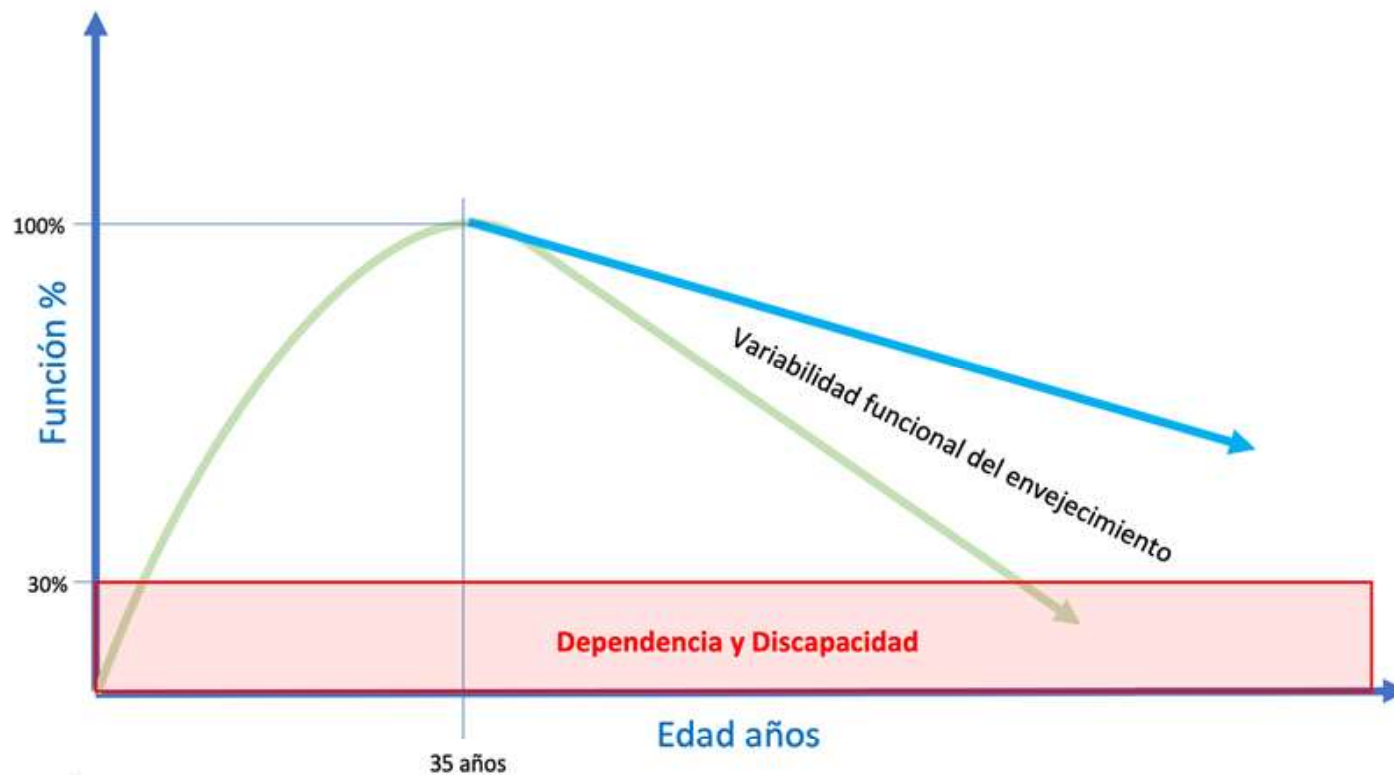
“Exercise is optional, but movement is essential”

Marcos Vázquez

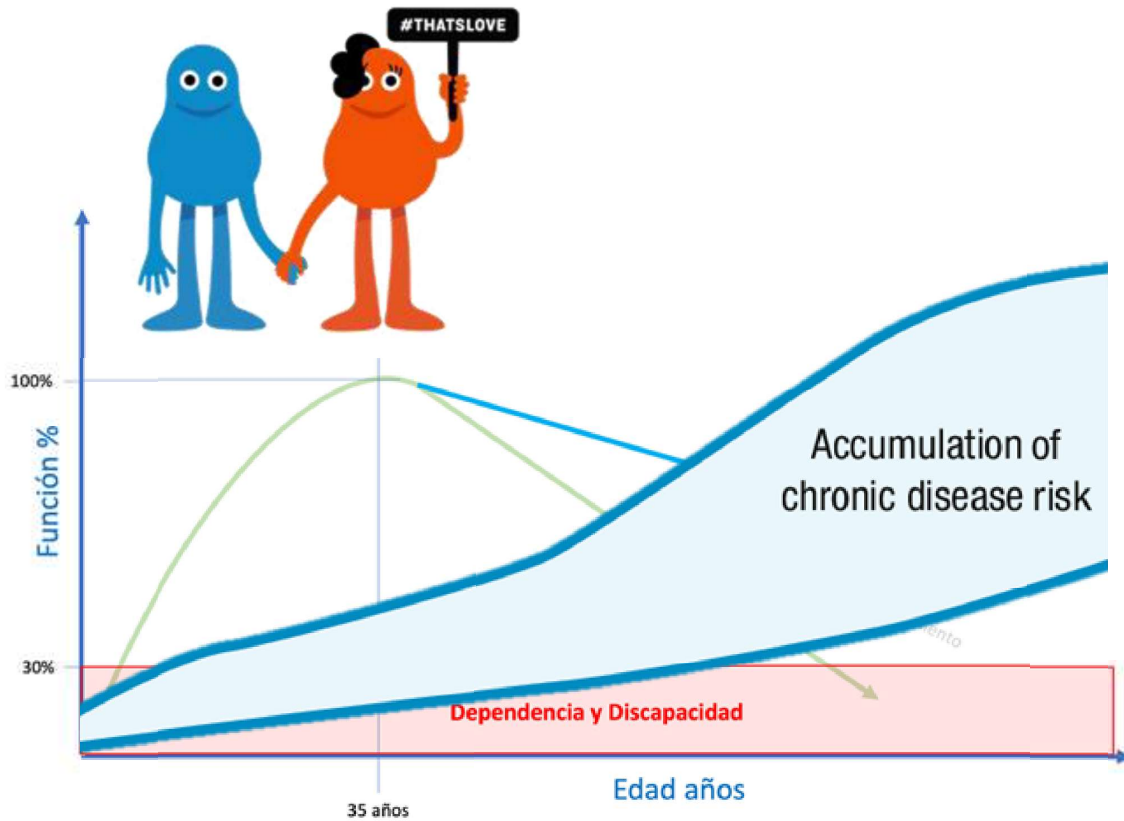
About the essentiality of movement as a lifestyle...



Ageing – Function Variability – Movement



Relationship between NCD and Functional Capacity

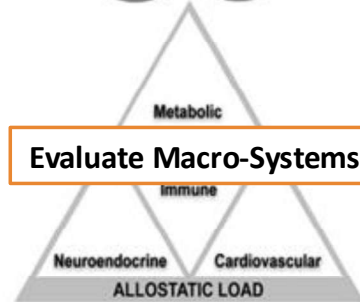


Nowadays, our lifespan is longer than before.
However, we also suffer more diseases than before.

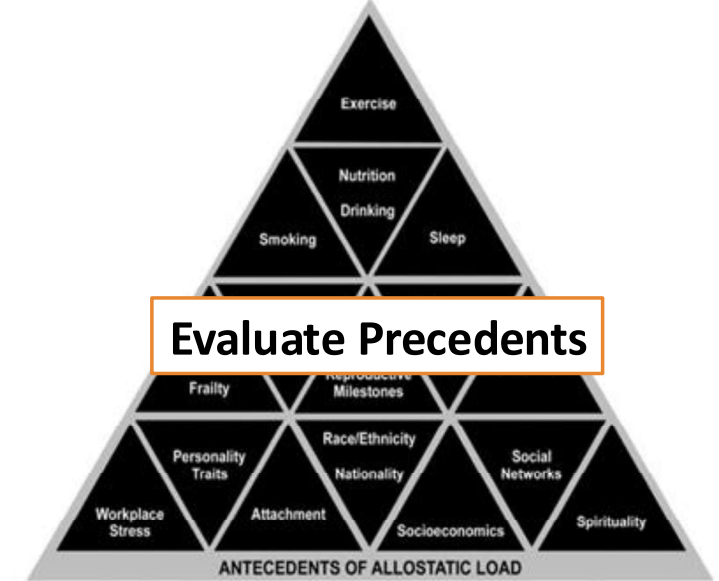
Impact in the Movement System



Evaluate Macro-Systems



Evaluate Precedents



The importance of identify and stratify in the clinical context

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Editorial

It's time for change with the management of non-specific chronic low back pain

Peter O'Sullivan

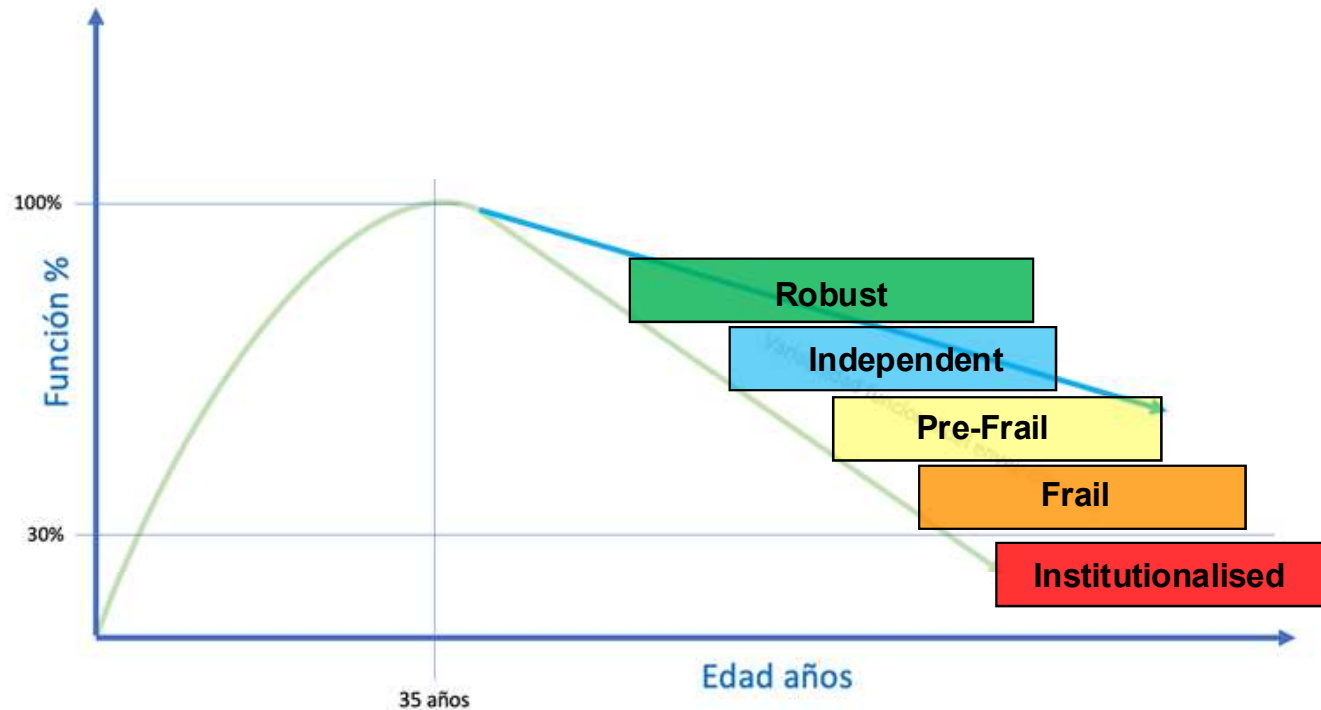
Geriatric Profile 0 = Institutionalised

Geriatric Profile 1 = Frail

Geriatric Profile 2 = Pre-Frail

Geriatric Profile 3 = Independent

Geriatric Profile 4 = Robust



How can we identify our elderly's functional state to do Physical Activity (PA)?

<p>Serious limitation DISABILITY</p> <p>Unable to walk Wheelchair or lying down in bed Unable to standing Unable to do STS</p>	<p>Moderate limitation FRAIL</p> <p>Able to walk, but with difficulties It is hard to complete balance tests</p>	<p>Mild limitation PRE-FRAIL</p> <p>Independent walk Mild walking disorders It is hard to complete the 5-STS</p>	<p>Minimal limitation INDEPENDENT</p>
<p>SPPB 0-3 GV (6m) < 0,5 m/s 5-STS > 20s TUG > 20s HGS < 10kg</p>	<p>SPPB 4-6 GV (6m) 0,5 – 0,8 m/s 5-STS 15-25s TUG > 20s HGS < 20kg</p>	<p>SPPB 7-9 GV (6m) 0,8 – 1.1 m/s 5-STS 10-15s TUG 10 - 20s HGS 20 - 30kg</p>	<p>SPPB 10-12 GV (6m) > 1.1 m/s 5-STS < 12s TUG < 10s HGS > 30kg</p>
<p>Institutionalised</p>	<p>Frail</p>	<p>Pre-Frail</p>	<p>Independent</p>
<p>Doing physical activity, you will be able to stand up from the wheelchair, come on!</p>	<p>Doing these exercises, he will notice a great improvement</p>	<p>The goal of the exercise is to keep enjoying the ability to walk</p>	<p>DO NOT SIT BACK! By stop doing PA, the elderly condition could quickly get worse</p>
<p>Ratio 1/1</p>	<p>Ratio 1/5</p>	<p>Ratio 1/10</p>	<p>Ratio 1/15</p>

Markers Based on **Ultrasonography**



Aging Clinical and Experimental Research
<https://doi.org/10.1007/s40520-019-01328-x>

ORIGINAL ARTICLE

Muscle thickness contribution to sit-to-stand ability in institutionalized older adults

A. Mateos-Angulo¹ · A. Galán-Mercant^{2,3} · A. I. Cuesta-Vargas^{1,4}

Received: 23 May 2019 / Accepted: 16 August 2019
© Springer Nature Switzerland AG 2019

Check for updates

diagnostics

Article

Muscle Thickness and Echo Intensity by Ultrasonography and Cognitive and Physical Dimensions in Older Adults

Alvaro Mateos-Angulo¹, Alejandro Galán-Mercant^{2,3,*} and Antonio Ignacio Cuesta-Vargas^{1,4}

¹ Department of Physiotherapy, IBIMA, University of Málaga, 29017 Málaga, Spain; amateos@uma.es (A.M.-A.); acuesta@uma.es (A.I.C.-V.)
² MOVE-IT Research Group and Department of Physical Education, Department of Nursing and Physiotherapy, Cádiz University, 11009 Cádiz, Spain
³ Biomedical Research and Innovation Institute of Cádiz (INIBICA) Research Unit, Puerta del Mar University Hospital, University of Cádiz, 11009 Cádiz, Spain
⁴ School of Clinical Sciences of the Faculty of Health, Queensland University of Technology, Brisbane 4000, Australia
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nutrients

Article

Ultrasound Muscle Assessment and Nutritional Status in Institutionalized Older Adults: A Pilot Study

Alvaro Mateos-Angulo¹, Alejandro Galán-Mercant^{2,*} and Antonio Ignacio Cuesta-Vargas^{1,3,4}

Markers Based on Kinematics



Galán-Mercant and Cuesta-Vargas *BMC Research Notes* 2014, **7**:640
<http://www.biomedcentral.com/1756-0500/7/640>



RESEARCH ARTICLE

Open Access

Mobile Romberg test assessment (mRomberg)

Alejandro Galán-Mercant¹ and Antonio I Cuesta-Vargas^{1,2*}

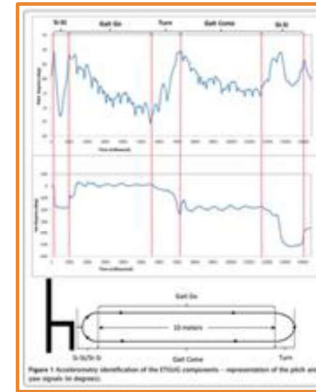


Figure 1 Accelerometry identification of the FTICG components - representation of the pitch and yaw signals in degrees.

Hindawi Publishing Corporation
 BioMed Research International
 Volume 2013, Article ID 279197, 6 pages
<http://dx.doi.org/10.1155/2013/279197>



Research Article

Differences in Trunk Kinematic between Frail and Nonfrail Elderly Persons during Turn Transition Based on a Smartphone Inertial Sensor

Alejandro Galán-Mercant¹ and Antonio I. Cuesta-Vargas^{1,2}

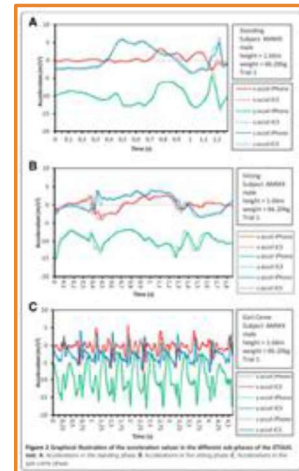


Figure 2 Graphical distribution of the acceleration values in the different sub-phases of the FTICG. Sub-A: Acceleration in the turning phase. Sub-B: Acceleration in the stop phase. Sub-C: Acceleration in the start phase.

Galán-Mercant and Cuesta-Vargas *BMC Research Notes* 2014, **7**:100
<http://www.biomedcentral.com/1756-0500/7/100>



RESEARCH ARTICLE

Open Access

Differences in trunk accelerometry between frail and non-frail elderly persons in functional tasks

Alejandro Galán-Mercant¹ and Antonio I Cuesta-Vargas^{1,2*}

Galán-Mercant et al. *BioMedical Engineering OnLine* 2014, **13**:156
<http://www.biomedical-engineering-online.com/content/13/1/156>



RESEARCH

Open Access

Reliability and criterion-related validity with a smartphone used in timed-up-and-go test

Alejandro Galán-Mercant¹, Francisco Javier Bardo-López², María T Labajos-Manzanares¹ and Antonio I Cuesta-Vargas^{1,2*}

IOP Publishing | Institute of Physics and Engineering in Medicine

Physiological Measurement

Physiol. Meas. **36** (2015) 1929–1942

doi:10.1088/0967-3334/36/9/1929


Clinical frailty syndrome assessment using inertial sensors embedded in smartphones

A Galán-Mercant¹ and A I Cuesta-Vargas^{1,2}

New tendencies **based on AI**


Knowledge-Based Systems 185 (2019) 104939

Contents lists available at ScienceDirect



Knowledge-Based Systems

journal homepage: www.elsevier.com/locate/knosys



Assessing physical activity and functional fitness level using convolutional neural networks[□]

Alejandro Galán-Mercant^{a,f}, Andrés Ortiz^{b,c,e}, Enrique Herrera-Viedma^{c,d}, Maria Teresa Tomas^e, Beatriz Fernandes^e, Jose A. Moral-Munoz^{a,f}

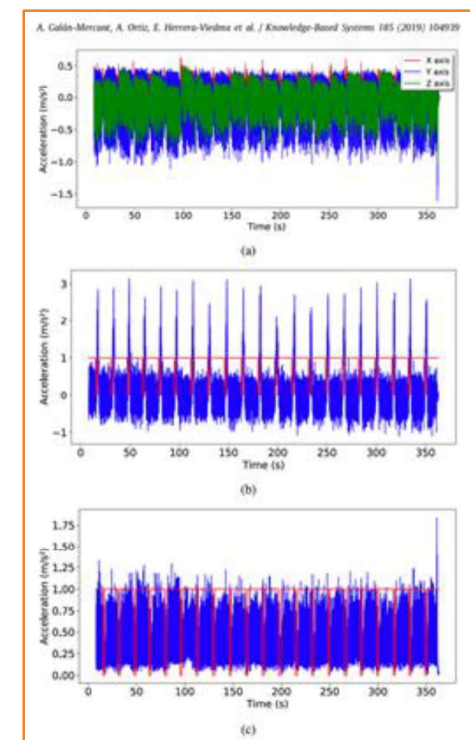
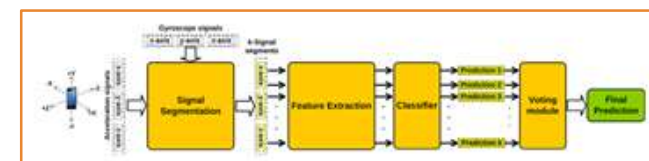
JOURNAL OF MEDICAL INTERNET RESEARCH

Velazquez-Diaz et al

Review

Use of Artificial Intelligence in the Identification and Diagnosis of Frailty Syndrome in Older Adults: Scoping Review

Daniel Velazquez-Diaz^{1,2*}, PhD; Juan E Arco^{3,4,5*}, PhD; Andres Ortiz^{3,4*}, Prof Dr, PhD; Verónica Pérez-Cabezas^{6,7*}, PhD; David Lucena-Anton^{7,8*}, PhD; Jose A Moral-Munoz^{7,8*}, PhD; Alejandro Galán-Mercant^{6,7*}, PhD



What is the **KEY** to identify the frailty syndrome?



Experimental Gerontology 142 (2020) 111141

Contents lists available at ScienceDirect

Experimental Gerontology

Journal homepage: www.elsevier.com/locate/expgero

Low relative mechanical power in older adults: An operational definition and algorithm for its application in the clinical setting

Jose Losa-Reyna^{a,b,c,1}, Julian Alcazar^{b,c,1}, Irene Rodríguez-Gómez^{b,c}, Ana Alfaro-Acha^{a,b}, Luis M. Alegre^{b,c}, Leocadio Rodríguez-Mañas^{b,d}, Ignacio Ara^{b,e}, Francisco J. García-García^{a,b,*}

^a Department of Geriatrics, Hospital Virgen del Valle, Complejo Hospitalario de Toledo, Toledo, Spain
^b CIBER of Frailty and Healthy Aging (CIBERFES), Madrid, Spain
^c GENUD Toledo Research Group, Universidad de Castilla-La Mancha, Toledo, Spain
^d Geriatric Department, Hospital Universitario de Getafe, Getafe, Spain

Experimental Gerontology 175 (2023) 112161

Contents lists available at ScienceDirect

Experimental Gerontology

Journal homepage: www.elsevier.com/locate/expgero

Comparison of unilateral and bilateral strength ratio, strength, and knee proprioception in older male fallers and non-fallers

Abdolhamid Daneshjoo^{a,b}, Hassan Sadeghi^{c,*}, Rasoul Yaali^d, David G. Behm^b

^a Department of Sports Injuries and Corrective Exercises, Faculty of Sports Sciences, Shahid Bahonar University of Kerman, Kerman, Iran
^b School of Human Kinetics and Recreation, Memorial University of Newfoundland, St. John's, Canada
^c Department of Biomechanics and Sports Injuries, Faculty of Physical Education and Sports Sciences, Kharazmi University, Tehran, Iran
^d Department of Motor Behavior, Faculty of Physical Education and Sports Sciences, Kharazmi University of Tehran, Tehran, Iran



Sex	n	P3	P10	P25	P50	P75	P90	P97
Men	337	2.5	2.6	2.7	2.9	3.2	3.6	4.3
Women	413	1.9	2.0	2.1	2.3	2.6	3.0	3.5

STS Muscular Power (<1,7 W·kg-1 🧑 and <2,2 W·kg-1 🧑)

Once they are identified, let us **Move and Teach them**

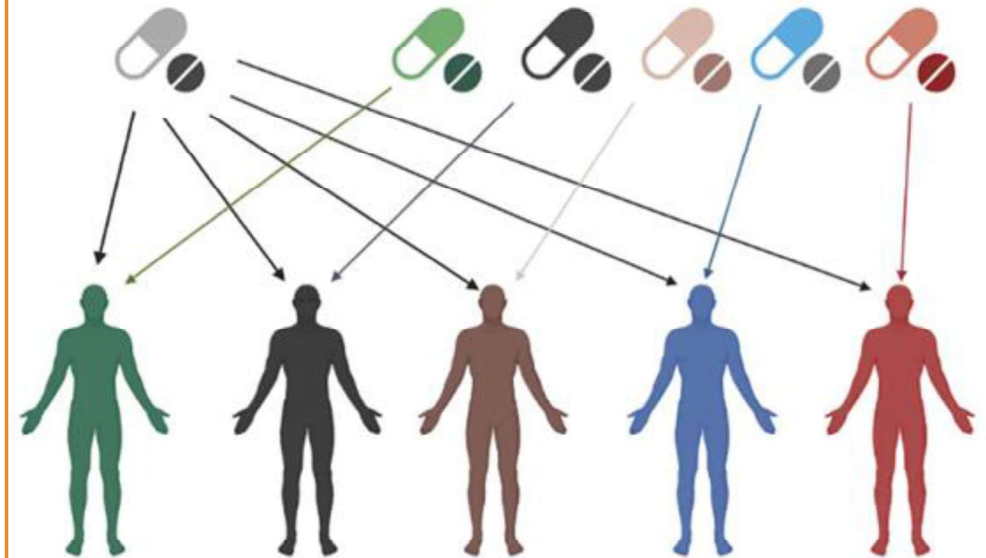
Exercise IS MEDICINE



... take one daily

Traditional Physical Therapy

Precision Physical Therapy



Personalized Medicine - Precision Medicine

Ongoing projects within the UCA University



Viability of an educational program for lifestyle changes and an algorithm for the derivation of exercise programs in older people at risk of dependency at primary care



Junta de Andalucía



PRICA-POW FRAIL Project



Record number in ClinicalTrial.gov

NCT05772910

Active projects within the UCA

Experimental

EDUcation / EXERcise / EDU + EXER

Cognitive Behavioural Intervention

Concurrent Training Programme

Leg-Press + Cardiorespiratory Fitness

Load adjustment and control with Encoder

Fatigue adjustment and control with Heart Rate monitoring.

Strength Block Protocol

5' cycle-ergometer – 70 bpm | Warmup
1 set 10 rep – 40-50% RM

According to profile from Algorithim:

- A) 6x12 40% of 1RM (Cognitive)
- B) 6x10 50% of 1RM (Sarcopenic)
- C) 6x6 80% of 1RM (Obese)



Control

Usual Care Treatment

Control of the PA levels

Cardiorespiratoy Fitness Block Protocol

Intensity adjustment from the threshold with **incremental** test until the **volitional fatigue**.

5' cycle-ergometer – 60 bpm (Warmup)

High-Intensity Interval training (HIIT)

30" - 30" a 90% - 40%

Ratio Q/Hamstrings/Gluteus as an intervention cornerstone

STS Muscular Power ($<1,7 \text{ W}\cdot\text{kg}^{-1}$ 🧑 and $<2,2 \text{ W}\cdot\text{kg}^{-1}$ 🧑)

Experimental Gerontology 142 (2020) 311141

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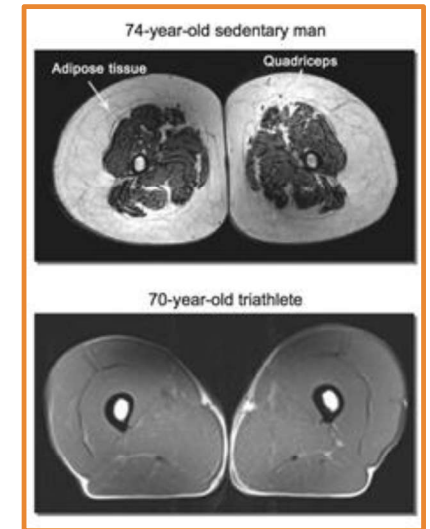
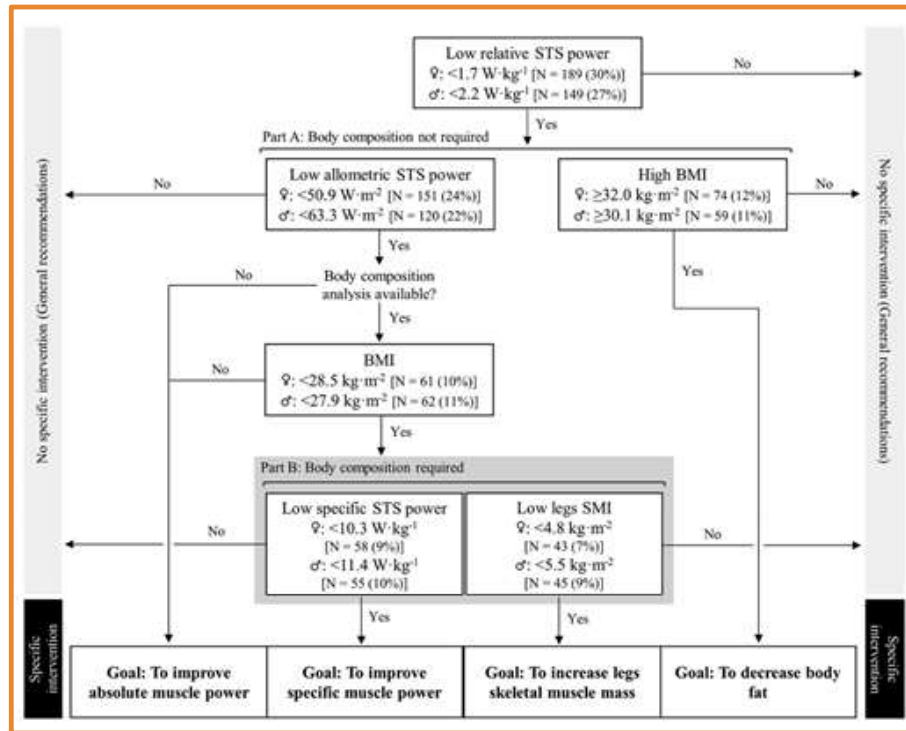
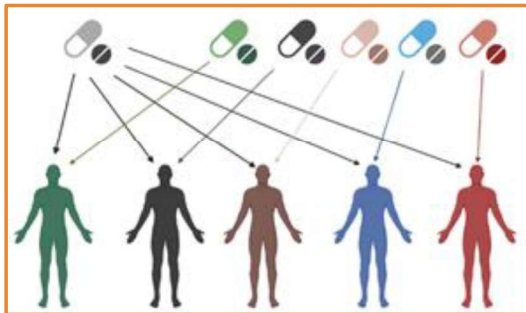
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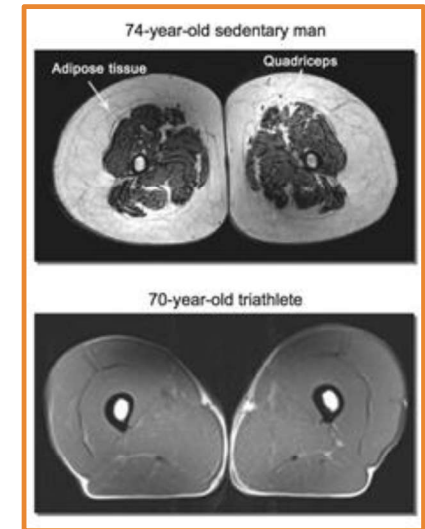
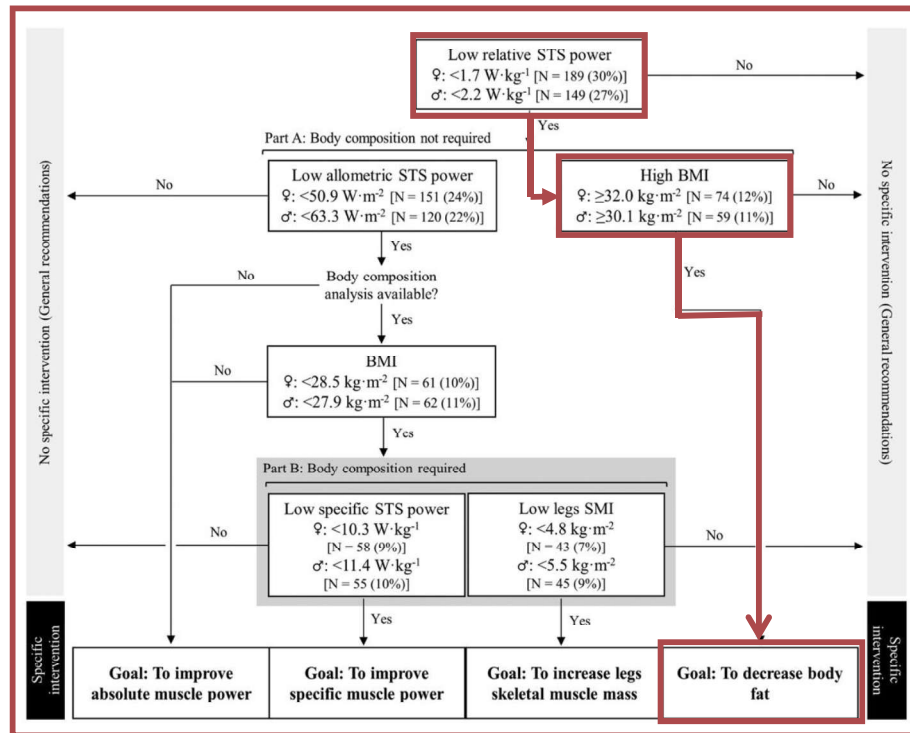
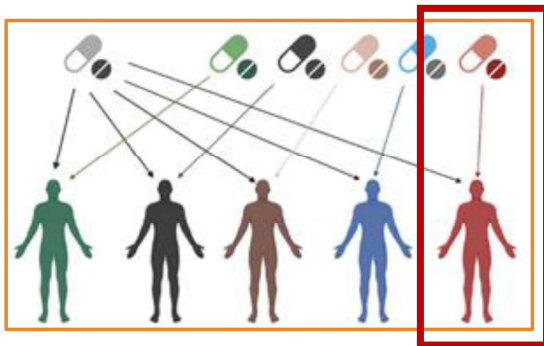
^a Department of Geriatrics, Hospital Virgen del Valle, Complejo Hospitalario de Toledo, Toledo, Spain
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^c IISGM III Toledo Research Group, Universidad de Castilla-La Mancha, Toledo, Spain
^d Geriatrics Department, Hospital Universitario de Galdakao, Galdakao, Spain



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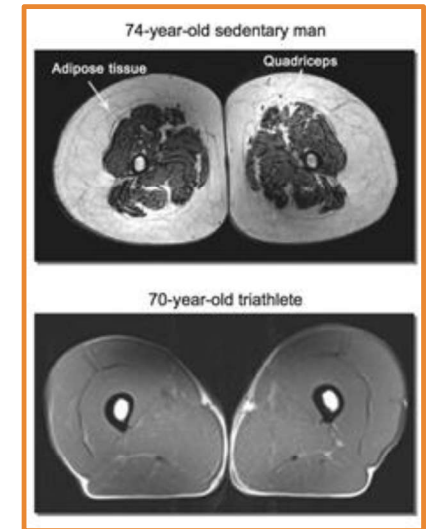
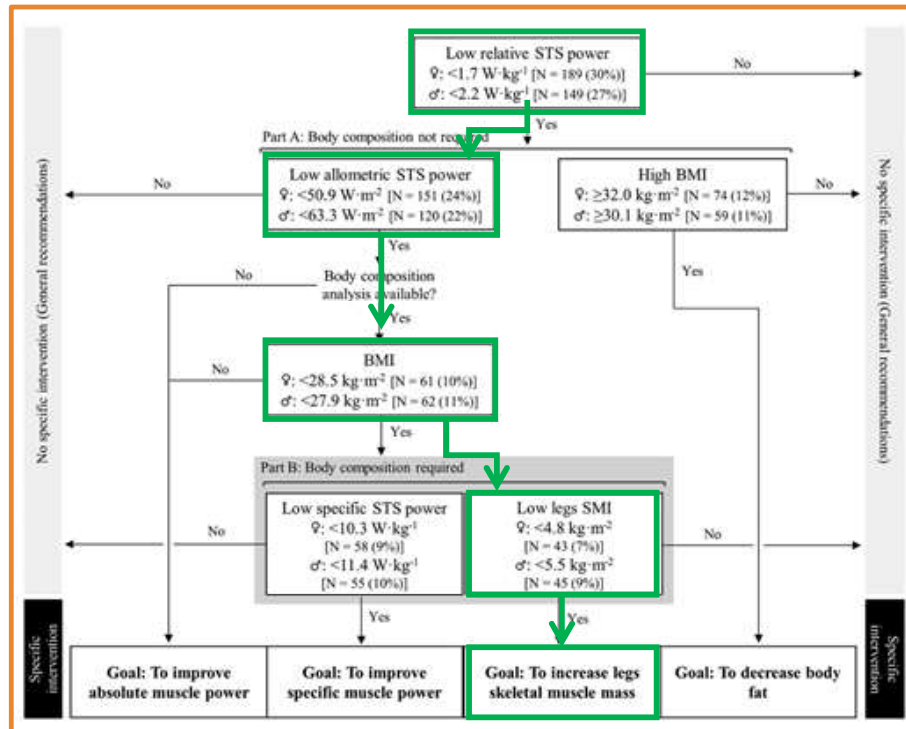
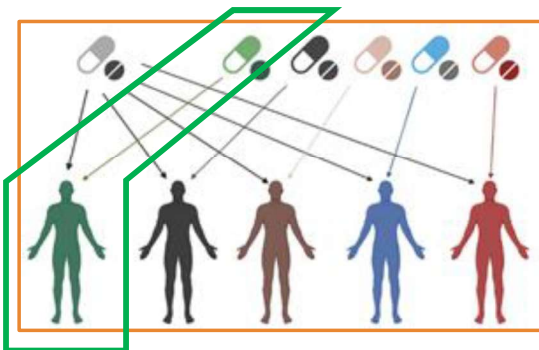
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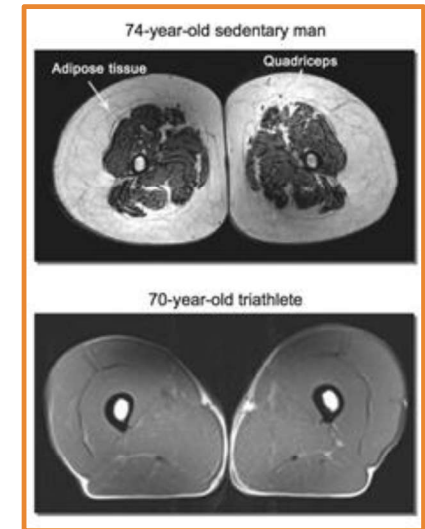
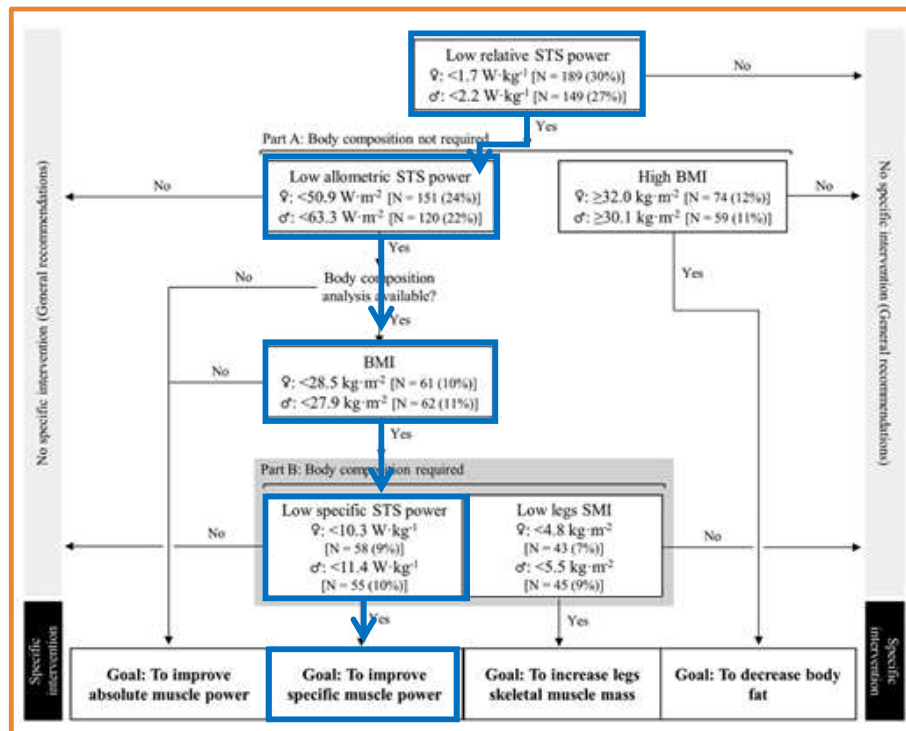
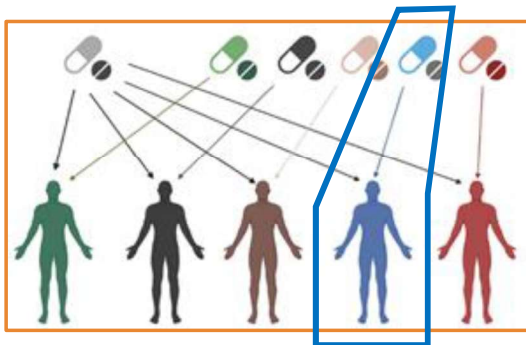
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MAIN VARIABLES

Muscular Power
STS

Intrinsic Capacity
ICOPE

PA level
Accelerometry

SECONDARIES VARIABLES

Questionnaires

Health Condition: **SF-12**

Quality of Life: **EuroQol5D**

Mood: **Profile of Mood States (POMS)**

Mini-mental state examination (**MMSE**)

Clinical measurements

Resting Heart Rate

Blood Pressure

Rectum Anterior muscular Thickness

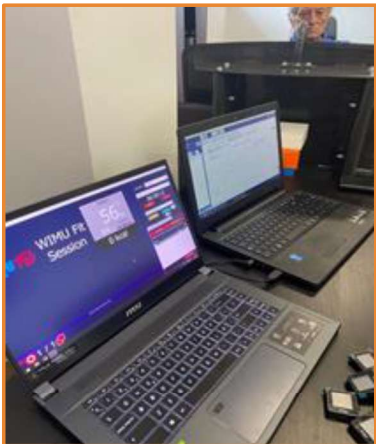
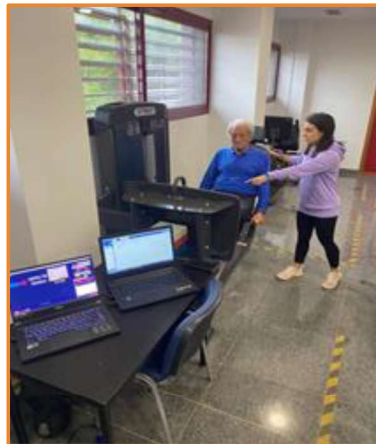
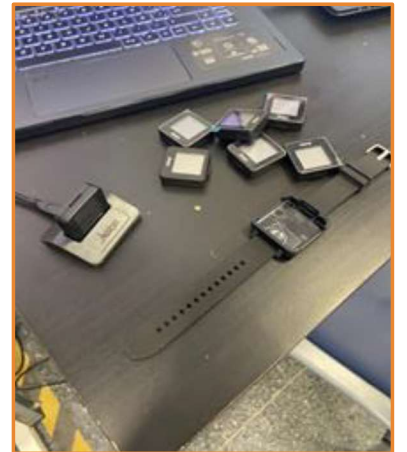
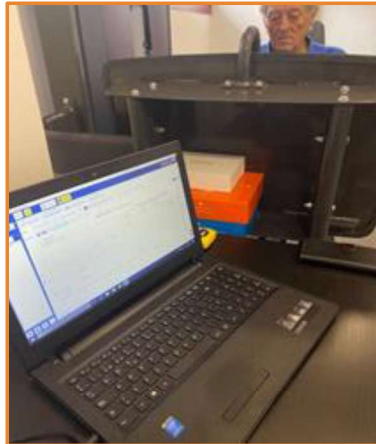
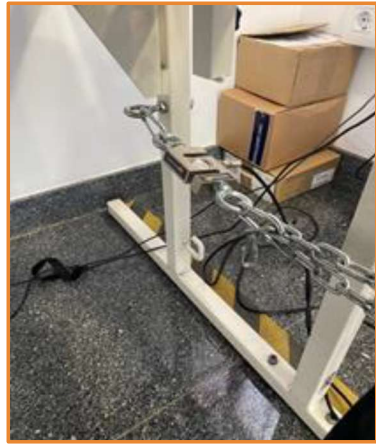
Ageing Markers in Blood

Others variables

6 MWT (or adapted)

Isometric Strength in Colson's Bench

Digital Biomarkers based on Artificial Intelligent processing



Finished projects within the UCA University



MOVE-IT Research Group
Cadiz University

“Promoting the shift sedentary Lifestyle towards active Ageing” *LifeAge Project*

National Research chall: ERASMUS+ SPORT 2018. (REF. 603121-EPP-1-2018-1-ES-SPO)

01/01/2019-31/12/2020 Quantity: 389.830 €

OVERALL OBJECTIVE: of the project is to assess the health consequences of ageing and sedentary lifestyle in European population and to promote physical activity and exercise as a key tool for a healthy and active ageing.

METHODS:

- 5 European countries / 6 centres (Finland; Italy; Irland, Latvia and Spain).
- 2 different age groups; 40 to 64 years old and 65 to 75 years old.

Erasmus+

Education, Audiovisual and Culture Executive Agency

Erasmus+: Sport, Youth and EU Aid Volunteers



Finished projects within the UCA University



MOVE-IT Research Group
Cadiz University



Efecto del ejercicio Físico supervisado a nivel Cerebral, COgnitivo y Metabólico en personas mayores con deterioro cognitivo ligero. Estudio EFICCOM

CALL: NATIONAL PROJECT R&D&I CHALLENGES 2017-2019
(DEP2016-76123-R)
Quantity: 120.000€

INfluencia de una inTervención con EjeRcicio Físico sobre Marcadores Asociados al Envejecimiento, Perfil Proteómico y Fragilidad. Estudio INTERMAE

CALL: SUBSIDIES FOR THE FINANCING OF BIOMEDICAL R&D&I AND HEALTH SCIENCES IN THE PROVINCE OF CADIZ 2018-2020
(PI-0002-2017)
Quantity: 492.107,54€



The importance of identify and stratify in the clinic context

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Editorial

It's time for change with the management of non-specific chronic low back pain

Peter O'Sullivan

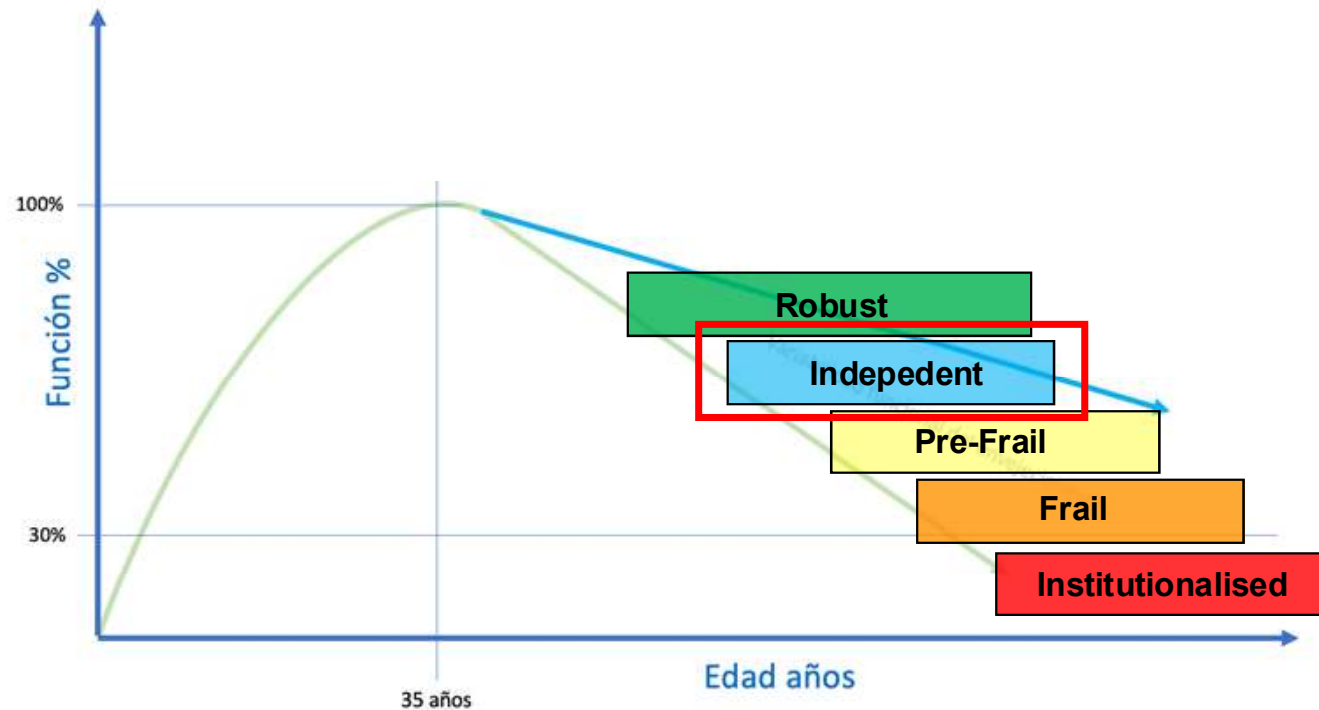
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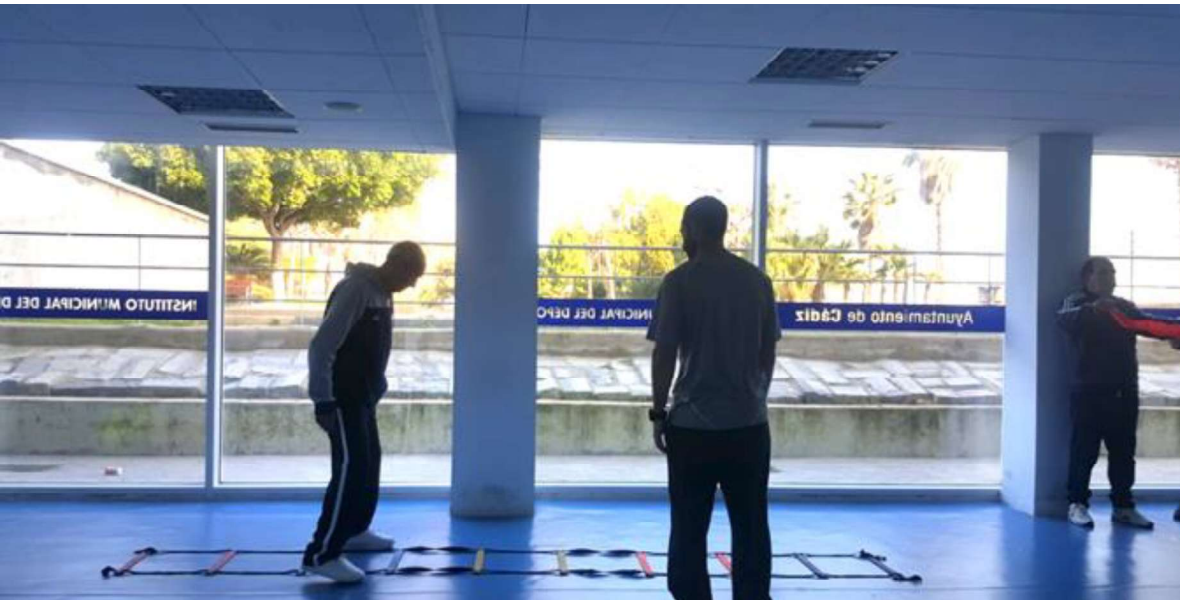
Geriatric Profile 4 = Robust



Examples of PA sessions and Evaluations





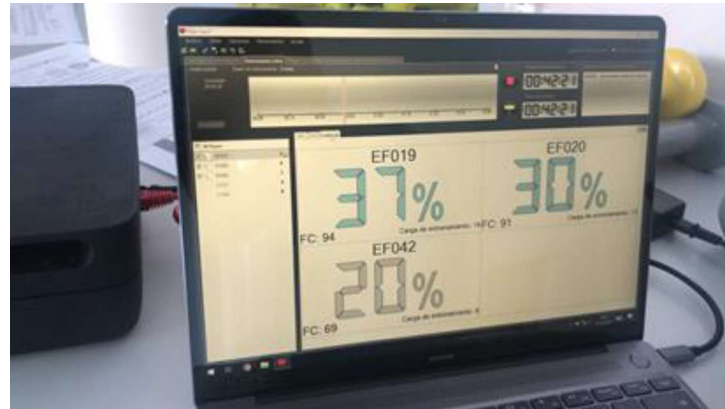




Examples of individualized monitoring

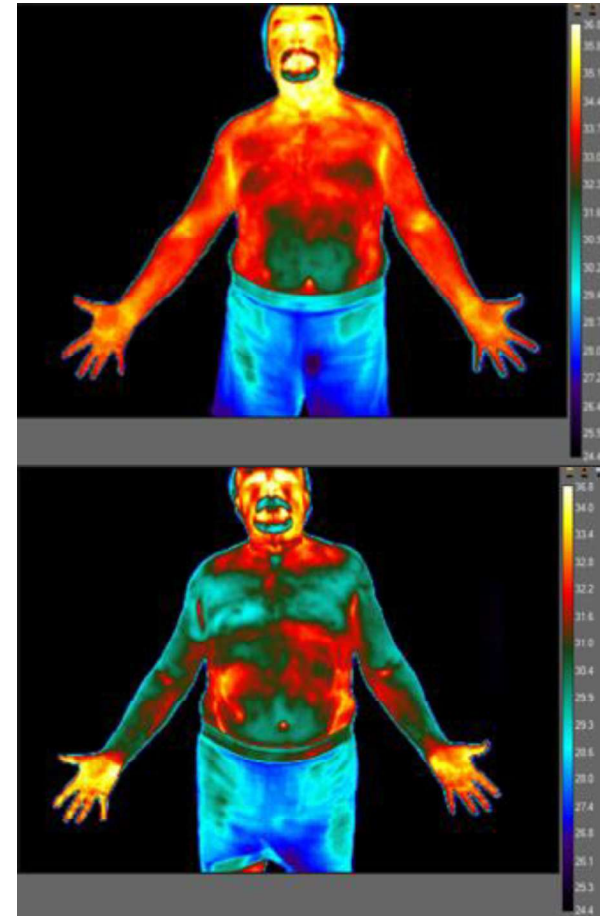
MODELO INDIVIDUALIZADOR Y PROGRESIVO EN SALUD																							
Macro ciclo		MACROCICLO IPS																					
Periodo	INDIVIDUALIZADOR				INCREMENTO PROGRESIVO												SALUD						
Mesociclo	INICIAL				INCREMENTO FUNCIONAL 1				INCREMENTO FUNCIONAL 2				INCREMENTO FUNCIONAL 3				CONTROL Y REESTRUC.						
Microciclo	EV	Adapt. Biolog.			DC	DC	DC	DC	DC	DC	EV	DC	DC	DC	DC	DC	DC	DC	EV	Es. Trans.			
Semana	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
Fecha	18/2/19	#####	4/3/19	#####	#####	#####	1/4/19	8/4/19	#####	#####	#####	6/5/19	#####	#####	#####	3/6/19	3/6/19	10/6/19	17/6/19	24/6/19			
Nº Sesiones	3	3	3	3	3	3	3	3	3	4	3	3	3	4	3	3	3	4	4	4			
CARGA ACUMULADA semanal (0-75)		37,50	41,25	45,00	45,00	52,50	52,50	60,00	60,00	60,00	80,00	45,00	52,50	56,25	80,00	60,00	62,50	66,25	70,00	70,00	70,00		
FASE DE PERIODIZACIÓN SELECTIVA		Lineal entre semana y lineal día a día						ondulatoria de semana a semana y entre día a día(para ello usamos el 4 día tb)												Lineal estable semanal			
Periodización lineal	1	1	1	1	1	1												1	1	1			
Periodización Ondulatoria							1	1	1	1	1	1	1	1	1	1	1						
Periodización Flexible								1		1		1		1		1							

Weekly Resting Heart Rate:
day 1 during warm-up.



Examples of laboratory sessions and evaluations

Infrared Thermography



IMC: 30,4

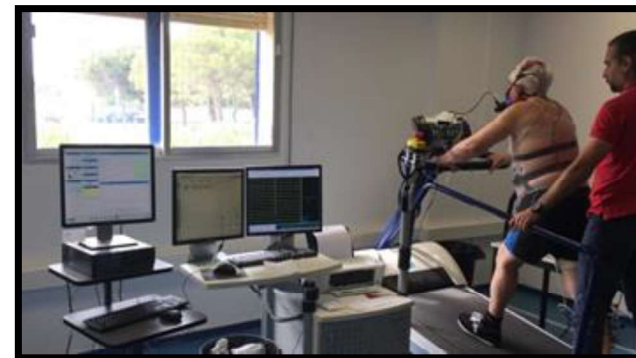
Examples of laboratory sessions and evaluations

NIRS + Basal Metabolism + Spirometry



Examples of laboratory sessions and evaluations

Incremental ergometry for Cardiorespiratory Fitness





Old is the Sea, but it still on movement... Keep in movement!



Thank you
very much