

CONGRESSO NAZIONALE PIEDE DIABETICO GDS AMD-SID
“LA SINDROME DEL PIEDE DIABETICO:
COMPETENZE IN AZIONE CON UNO SGUARDO AL FUTURO”
Assisi (PG) 15 - 17 giugno 2023

SESSIONE 3

**IL TEAM MULTIDISCIPLINARE NELLA PREVENZIONE PRIMARIA E NELLA PREVENZIONE
SECONDARIA**

**Il ruolo dell'esercizio fisico nella
prevenzione primaria e secondaria**

**Disfunzione Neuro-Muscolare e Esercizio Fisico
nella persona con diabete**

Prof. Stefano Balducci

Medico di Base Asl RM5

ASN a professore di seconda fascia in

Endocrinologia e Scienze dell' Esercizio e dello Sport

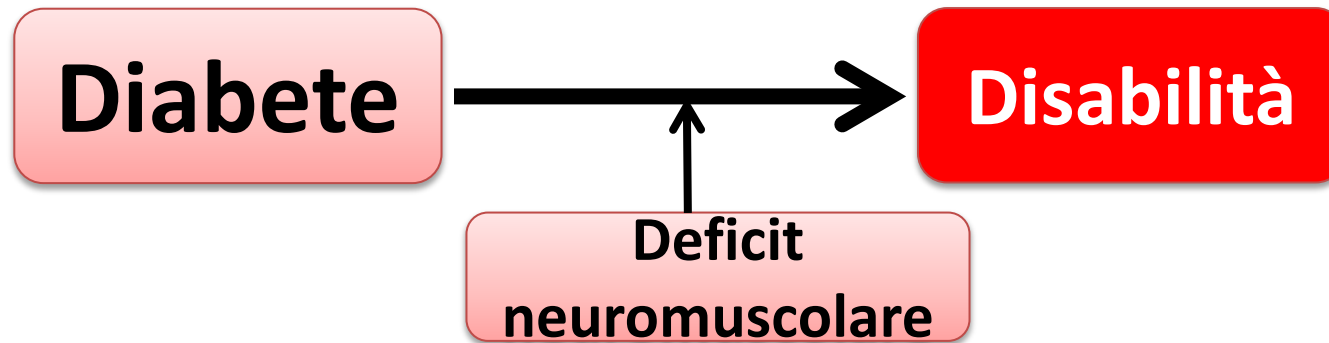
Disfunzione Neuro-Muscolare e Esercizio Fisico nella persona con diabete

Che cosa è già conosciuto:

- I pazienti diabetici hanno un rischio 2-3 volte maggiore di sviluppare disabilità fisiche

Wong et al. Diabetes and risk of physical disability in adults: a systematic review and meta-analysis. *Lancet Diabetes Endocrinol* 2013; 1: 106-14.

Diabete e funzione neuromuscolare

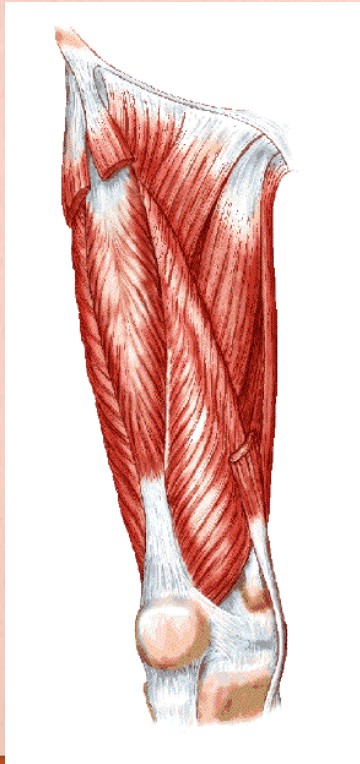


Quali sono le questioni a cui cercheremo di rispondere:

I Diabetici presentano alterazioni muscolari e tendinee: come?

- Può l'esercizio fisico contribuire a prevenire la progressione delle alterazioni neuro-muscolari, le ulcere, le re-ulcerazioni e le amputazioni?

Relationship between Muscle and diabetes



Mass

Strength

Fatigability

si riferisce alla velocità con cui i muscoli si indeboliscono dopo l'esercizio o il movimento e la quantità di tempo necessaria per recuperare o tornare alla loro piena potenza.

Excessive Loss of Skeletal Muscle Mass in Older Adults With Type 2 Diabetes

SEOK WON PARK ET AL. DIABETES CARE, 2009

Composizione corporea in
2.675 (70- 79 anni)
 DEXA annualmente per 6 anni



MASSA MUSCOLARE

	<u>Without diabetes</u>	<u>With diabetes</u>
Total lean mass (g/year)	-198 ±10	-222 ± 29
<u>Appendicular lean</u> (g/year)	-150 ±5	-187 ±16

Accelerated atrophy of lower leg and foot muscles—a follow-up study of long-term diabetic polyneuropathy using magnetic resonance imaging (MRI)

C. S. Andreassen • J. Jakobsen • S. Ringgaard • N. Ejlskjær • H. Andersen
 Diabetologia (2009) 52:1182–1191

Aims/hypothesis The aim of the study was to determine the loss of muscle volume in the lower leg and foot in long-term diabetic patients in relation to the presence of neuropathy.

Leg Muscle	Dorsal Flexors
	Annual Change %
	No Neuropathic - 1.9
	Neuropathic - 4.5
Foot Muscle	Plantar Flexors
	Annual Change %
	No Neuropathic - 1.8
	Neuropathic - 5.0
	No Neuropathic - 1.3
	Neuropathic - 3.0

Type 2 Diabetes, Muscle Strength, and Impaired Physical Function

The tip of the iceberg?

DIABETES CARE, VOLUME 28, NUMBER 10, OCTOBER 2005

AVAN AIHIE SAYER, FRCP
ELAINE M. DENNISON, MRCP
HOLLY E. SYDDALL, MSC

HELEN J. GILBODY, BSC
DAVID I.W. PHILLIPS, FRCP
CYRUS COOPER, FRCP

normal glucose tolerance was 2.73 ($P < 0.001$) and in those with IGT compared

Relazione tra controllo glicemico, forza muscolare e funzione fisica

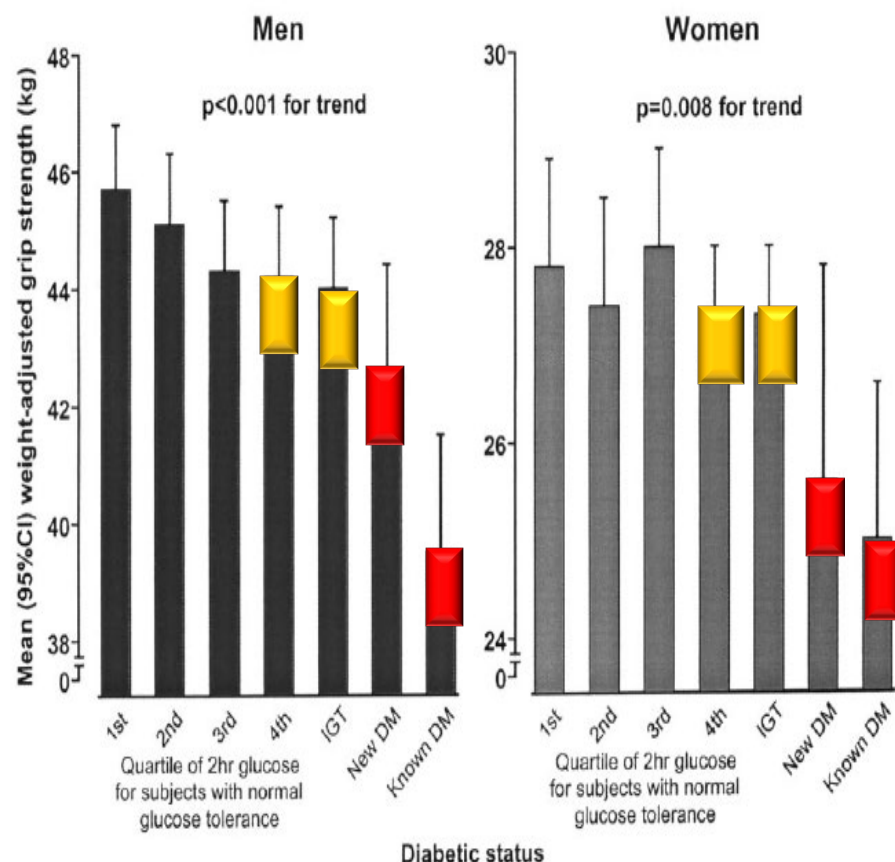


Figure 1—Relationship between weight-adjusted grip strength and diabetes status in men and women.

“Our findings suggest a graded association between increased glucose level, weaker muscle strength, and impaired physical function not only in older men with diabetes or IGT, but also in those without either diagnosis.”

Maximal voluntary isometric contraction (MVIC) at the upper (Panel A) and lower body (Panel B) in type 2 diabetes (T2D) men and women compared with control group (CG)

Giorgio Orlando¹
Stefano Balducci^{2,3}
Ilenia Bazzucchi¹
Giuseppe Pugliese²
Massimo Sacchetti^{1*}

Diabetes/Metabolism
Research and Reviews

Diabetes Metab Res Rev (2016)

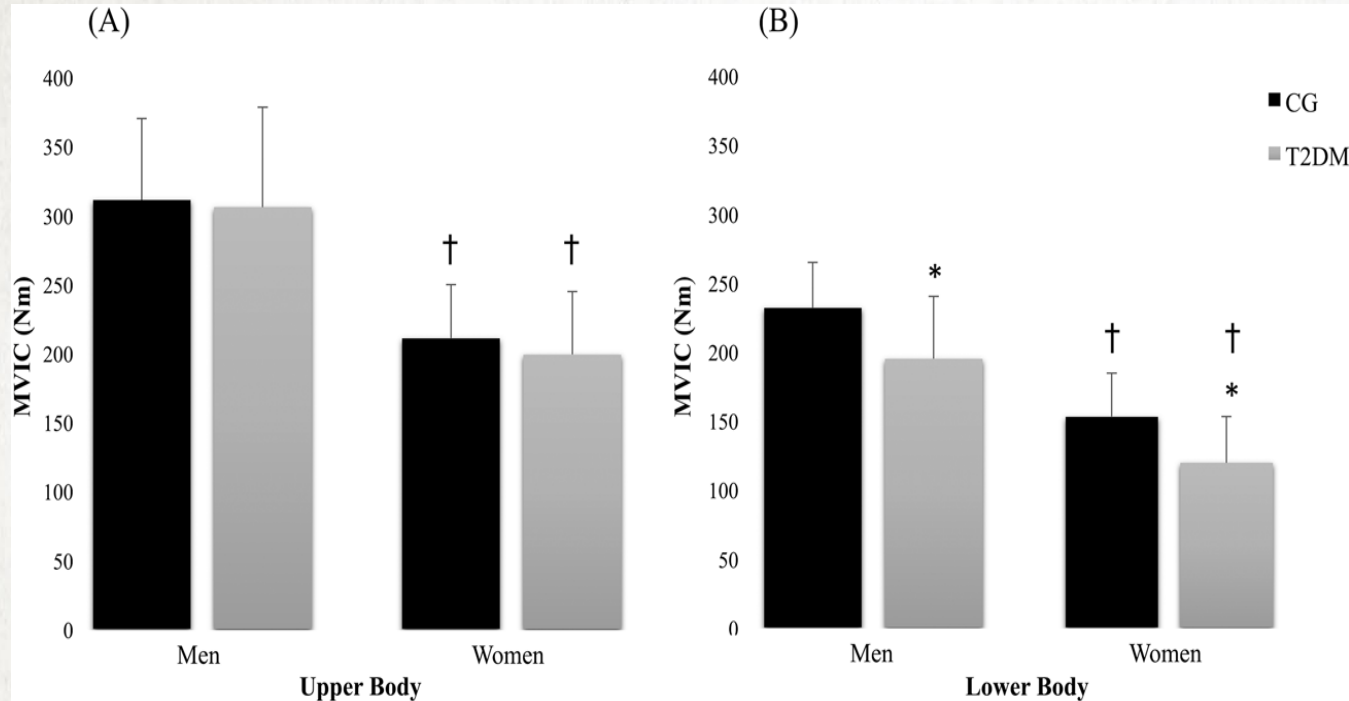
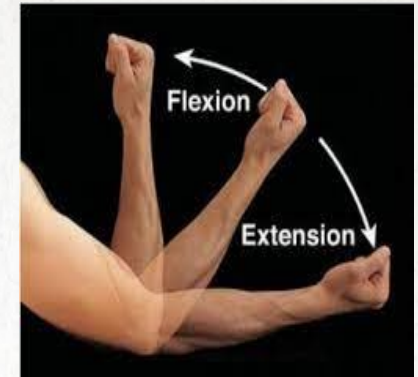
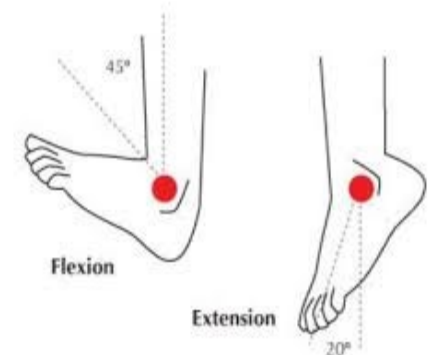
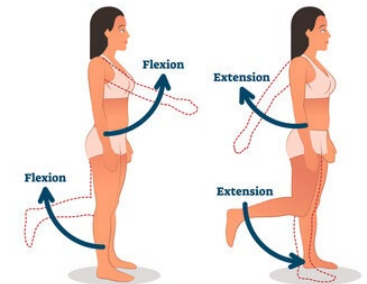


Figure 1. Maximal voluntary isometric contraction (MVIC) at the upper (Panel A) and lower body (Panel B) in type 2 diabetes (T2D) men and women compared with control group (CG). *Significantly lower than control ($p < 0.05$), †significantly lower compared with men ($p < 0.05$). Values are means $\pm$ standard deviations.



FLEXION AND EXTENSION



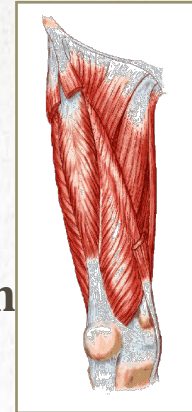
Correlates of muscle strength in diabetes

The study on the assessment of determinants of muscle and bone strength abnormalities in diabetes (SAMBA)

S. Balducci^{a,b,c,*}, M. Sacchetti^d, G. Orlando^d, L. Salvi^a,
L. Pugliese^{a,b}, G. Salerno^a, V. D'Errico^{b,c}, C. Iacobini^a,
F.G. Conti^{a,b}, S. Zanuso^e, A. Nicolucci^f, G. Pugliese^{a,b}

Nutrition, Metabolism & Cardiovascular Diseases (2013) xx, 1–9

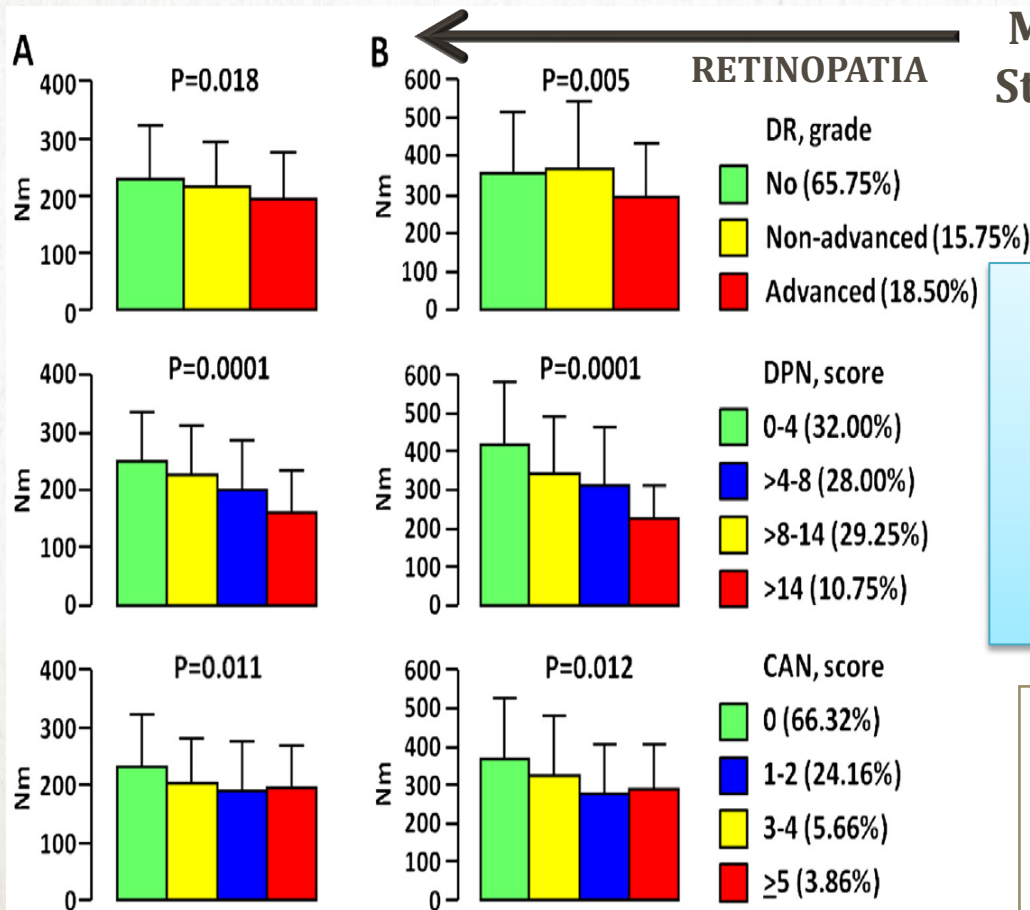
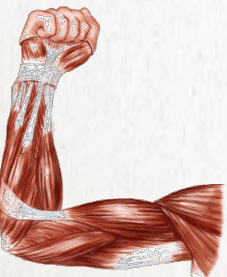
400
type 1 and 2 patients



LOWER
Muscle
Strength



UPPER
Muscle
Strength



Both upper and lower body muscle strength correlate with measures of diabetic complications and particularly with parameters of sensory and especially autonomic nerve function,

Il decadimento della forza muscolare è in relazione alla severità delle complicanze

0 = normal;
1 = borderline
2 = abnormal.

DIABETE E PERFORMANCE

*AFFATICABILITÀ
MUSCOLARE*



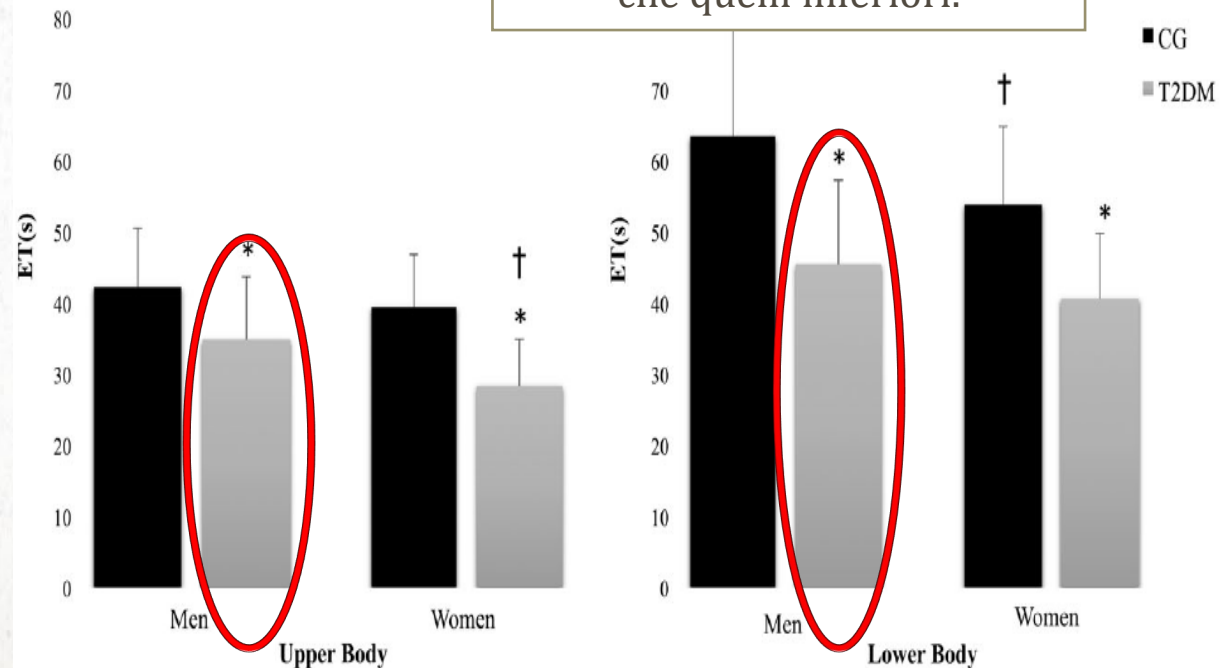
Muscle fatigability in type 2 diabetes

Giorgio Orlando¹
Stefano Balducci^{2,3}
Ilenia Bazzucchi¹
Giuseppe Pugliese²
Massimo Sacchetti^{1*}

I pazienti diabetici indipendentemente dalla presenza di complicanze micro e macrovascolari presentano una maggiore affaticabilità muscolare che interessa sia gli arti superiori che quelli inferiori.

Table 2. Clinical characteristics of diabetic patients

Variable	Men (n = 18)	Women (n = 15)	p Value
Diabetes duration (years)	9.1 ± 4.9	10.2 ± 7.6	0.620
HbA _{1c} (%)	6.9 ± 1.2	6.8 ± 1	0.833
FPG (mg/dL)	121.2 ± 33.6	127.6 ± 28.5	0.562
Triglycerides (mg/dL)	170 ± 78.4	178.8 ± 68.2	0.736
Total cholesterol (mg/dL)	183 ± 37	172 ± 35.9	0.399
HDL cholesterol (mg/dL)	49.7 ± 14.5	44.8 ± 9.8	0.281
LDL cholesterol (mg/dL)	102.2 ± 35.3	95.4 ± 34.4	0.584
Serum creatinine (mg/dL)	0.91 ± 0.15	0.75 ± 0.10	0.002
eGFR (mL/min/1.73 m ²)	89.2 ± 14.2	86 ± 13.3	0.523
Carotid IMT (mm)	1.06 ± 0.11	1.05 ± 0.11	0.846
ABI	0.96 ± 0.08	0.94 ± 0.06	0.442
Systolic BP (mmHg)	132.2 ± 8.2	129.3 ± 9.6	0.360
Diastolic BP (mmHg)	80.2 ± 7.9	77.3 ± 9	0.327
PMN conduction velocity (m/s)	49.2 ± 1.19	49.4 ± 0.81	0.515
PMN distal latency (m/s)	4.4 ± 0.28	4.3 ± 0.22	0.662
SSN conduction velocity (m/s)	48 ± 1.8	48.1 ± 1.4	0.948
SSN distal latency (m/s)	3.2 ± 0.28	3.1 ± 0.29	0.337
VPT malleolus (mV)	13.7 ± 3.2	12.2 ± 5	0.308
VPT hallux (mV)	12.2 ± 5.1	9.4 ± 2.6	0.067



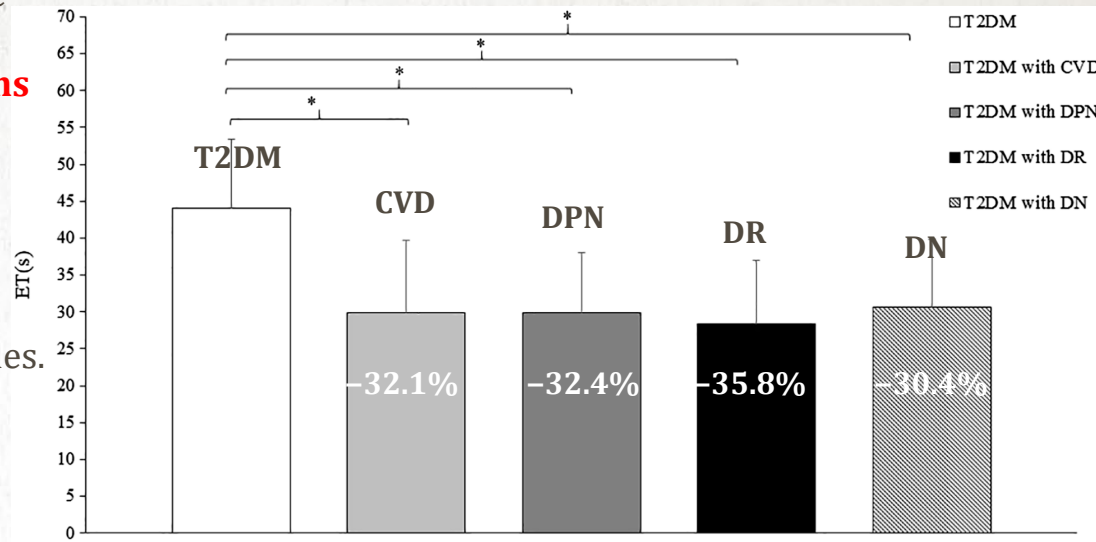
Muscle fatigability in patients with type 2 diabetes: relation with long-term complications

Orlando G and Balducci S. *Diabetes Metab Res Rev* . 2020 Feb;36(2):e3231.

Aims: The purpose of this study was to investigate the association between **muscle fatigability** and **microvascular** and **macrovascular complications** in patients with T2DM.

Methods: 146 patients with T2DM (80 M, 66 F, aged 66.9 ± 7.9 years) were recruited. **Maximal voluntary contraction** (MVC) and **endurance time** (ET, 50% of the MVC) knee extensor muscles. Univariate and multivariate correlations of ET values with diabetic complications, and CV risk factors were examined.

Lower body endurance time (ET)



Results: A higher muscle fatigability was detected in patients with DPN, ET: -32.4%, CVD, ET: -32.1%, Retinopathy ET: -35.8%, Nephropathy ET: -30.4%. Multivariate analysis showed that, ET was independently associated with sensory nerve conduction velocity, VPT, and ABI. In addition, ET values were independently associated with the presence of DPN, CVD, and retinopathy.

Conclusions: In T2DM, muscle fatigability is associated with presence of DPN, CVD, and retinopathy. Such defect appears to be mediated predominantly by Nerve and peripheral vascular dysfunction.

The impact of type 1 diabetes and diabetic polyneuropathy on muscle strength and fatigability

Giorgio Orlando¹ · Stefano Balducci^{2,3,4} · Ilenia Bazzucchi¹ · Giuseppe Pugliese^{2,3} · Massimo Sacchetti¹ 

FATIGABILITA' MUSCOLARE

Relazione tra il tempo di endurance e la velocità di conduzione nervosa

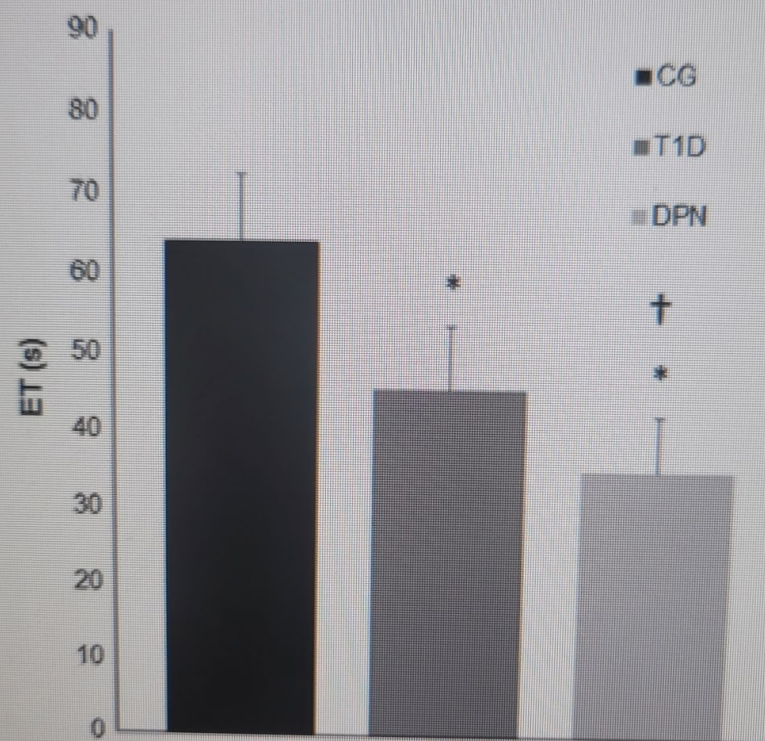
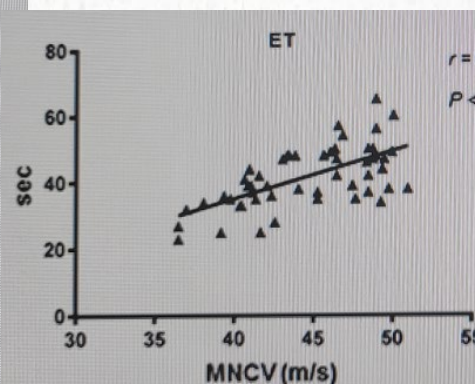
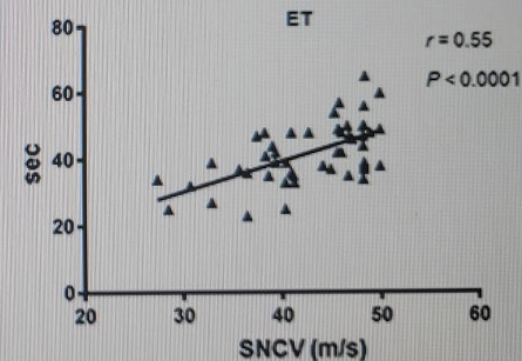


Fig. 2 Endurance time (ET) of the knee extensors in nondiabetic control subjects (CG), uncomplicated type 1 diabetic patients (T1D) and in patients with diabetic polyneuropathy (DPN). *Significantly lower than control ($p < 0.05$), †significantly lower compared with T1D group



(N. Peroneale)



(N. Surale)

Deficit:

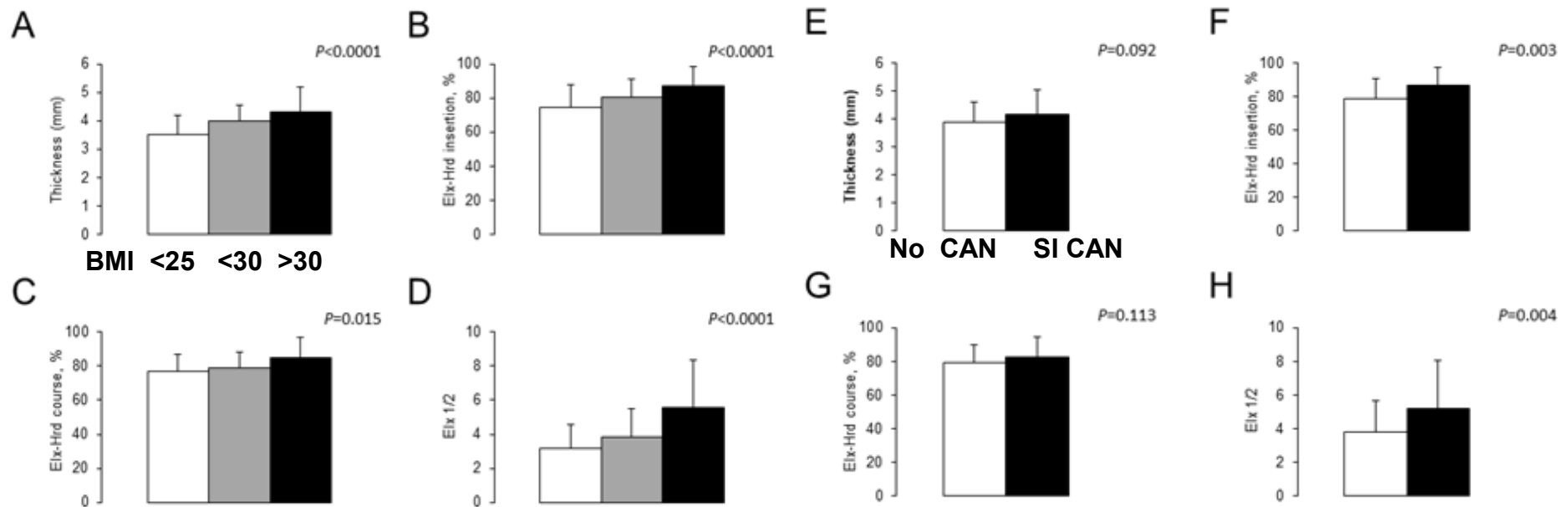
- 22,2% T1D vs Control
- 45,5% T1DN vs Control

A lower endurance time it is aggravated by DPN. Our data suggest that factors other than nervous damage play a role in the pathogenesis of such defect

Correlates of the Ultrasonographic and Elastosonographic Parameters of the Plantar Fascia in Patients with Type 2 Diabetes

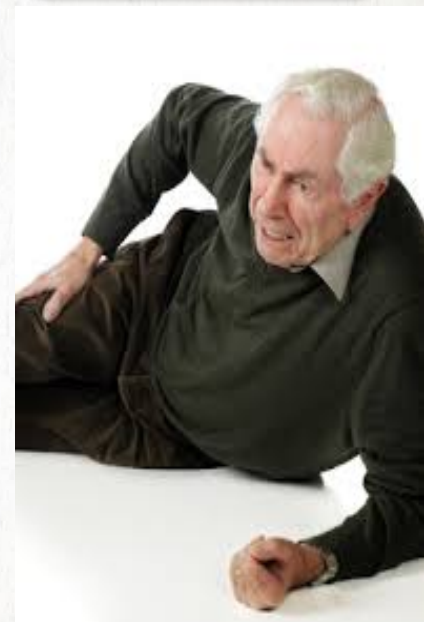
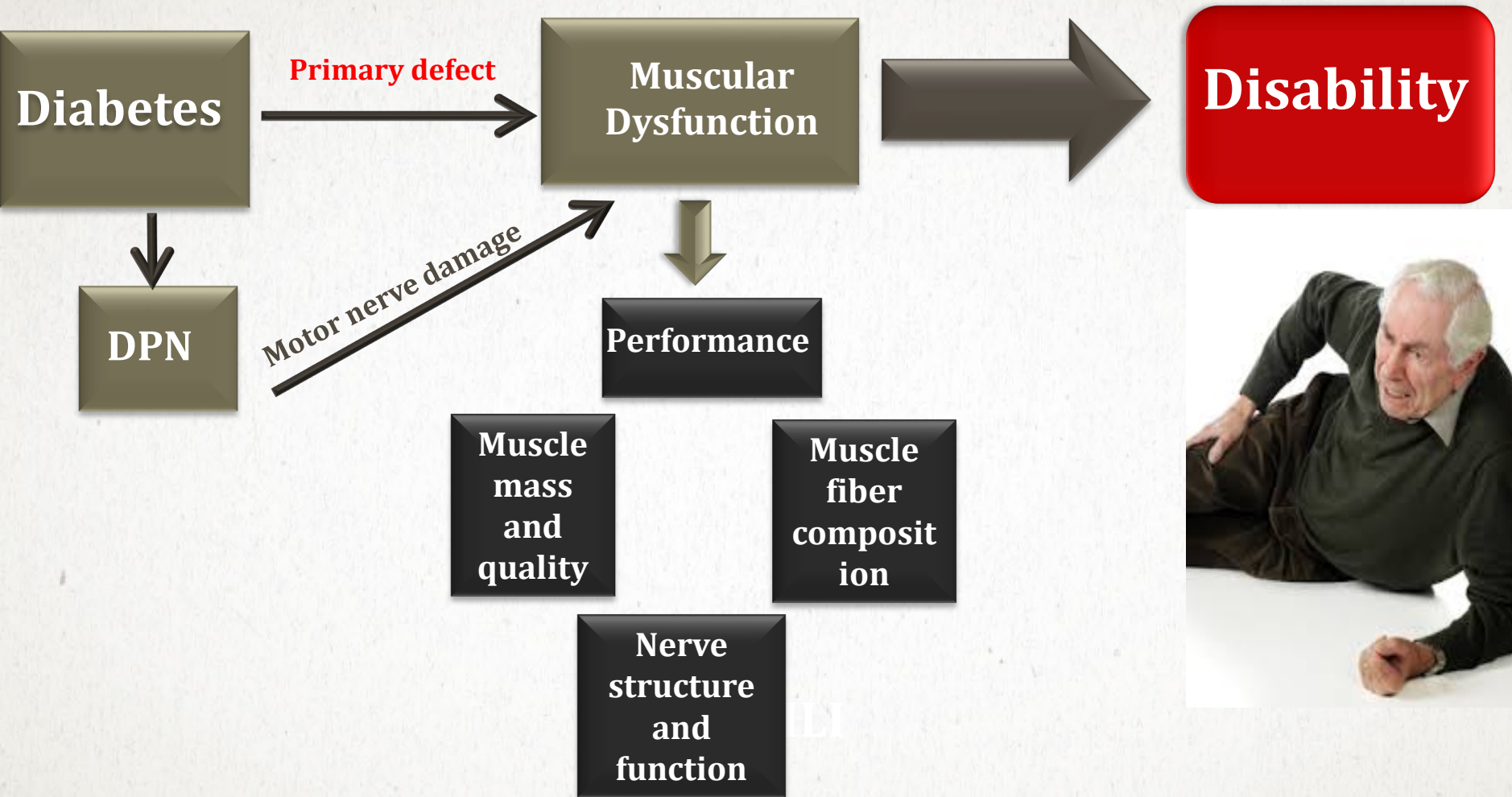
Flavia Santoboni, Stefano Balducci et al . Muscles, Ligaments and Tendons Journal 2023;13 (1)

Background. Prevalence of plantar fasciitis is increased in type 2 diabetes. This study was aimed at assessing the correlates of ultrasonographic and elastosonographic parameters in plantar fascia (PF) individuals with type 2 diabetes encompassing various degrees of complications

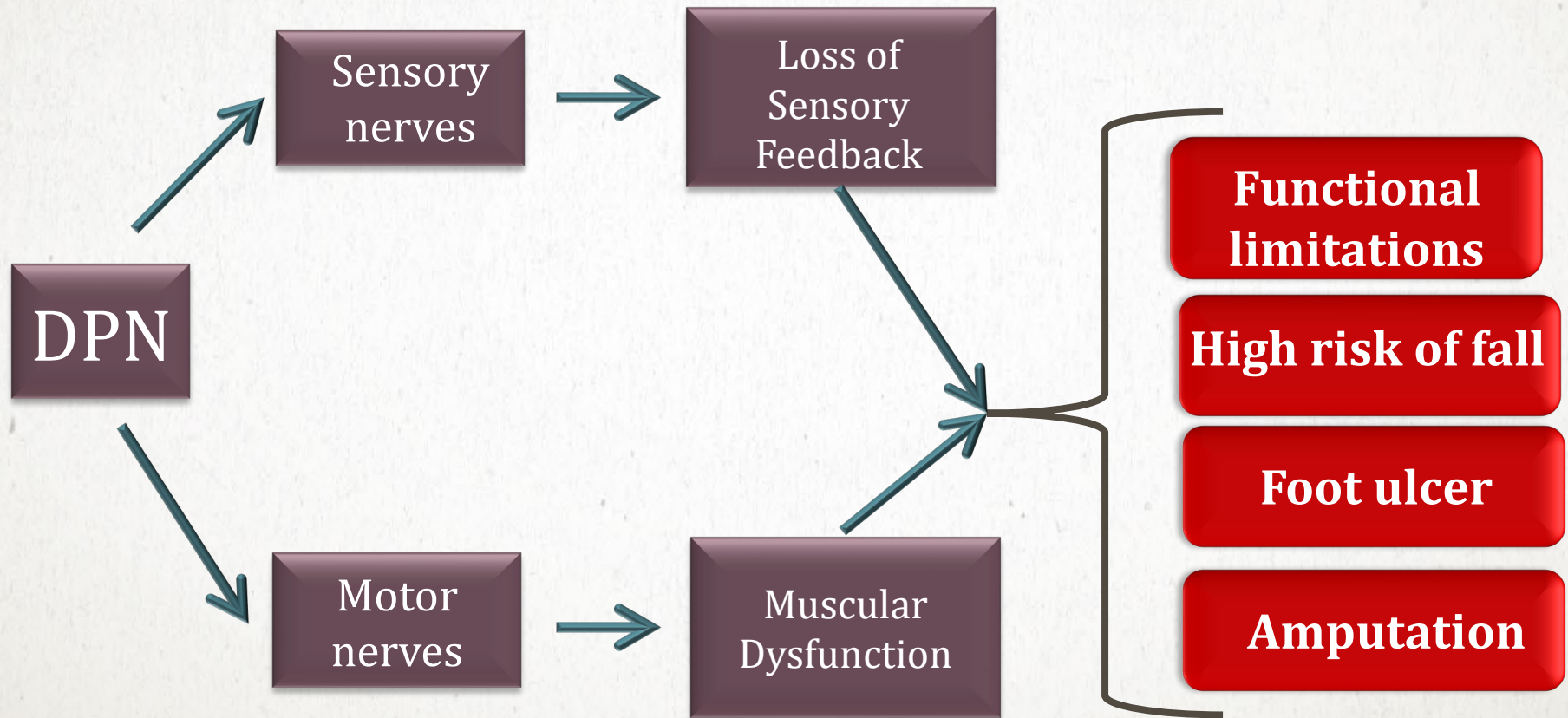


Conclusions. Adiposity, body composition and presence of CAN are the main correlates of plantar fascia ultrasonographic and elastosonographic parameters, suggesting that body weight reduction, maintenance of muscle mass, and prevention of neuropathic complications may result in a decreased incidence of plantar fasciitis in individuals with type 2 diabetes.

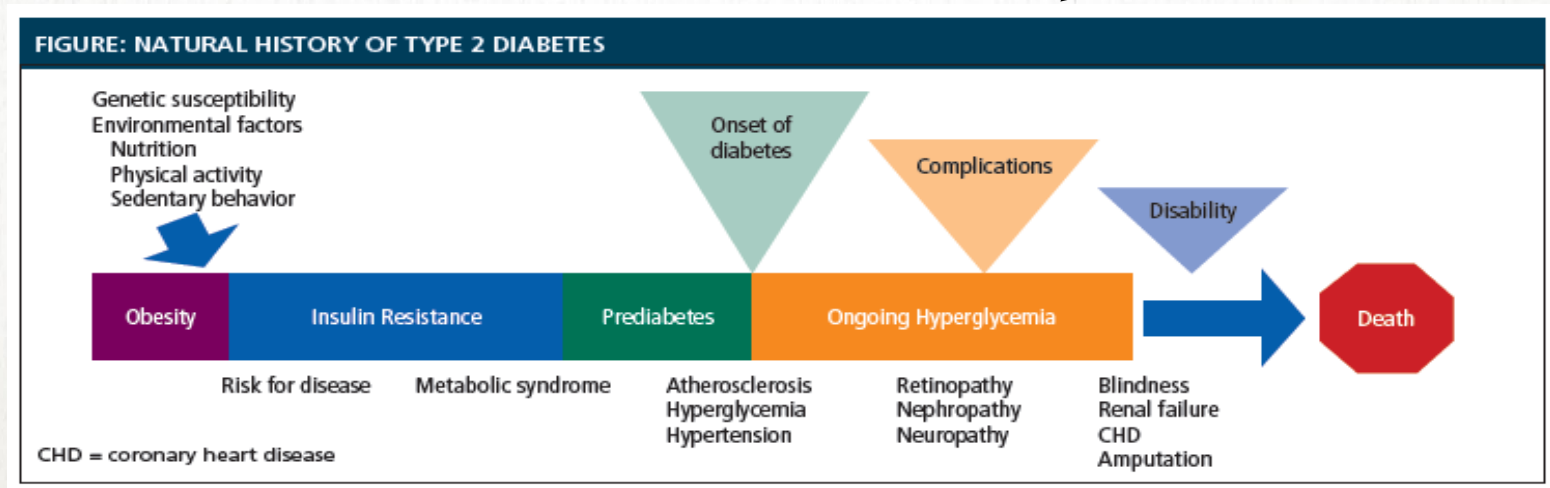
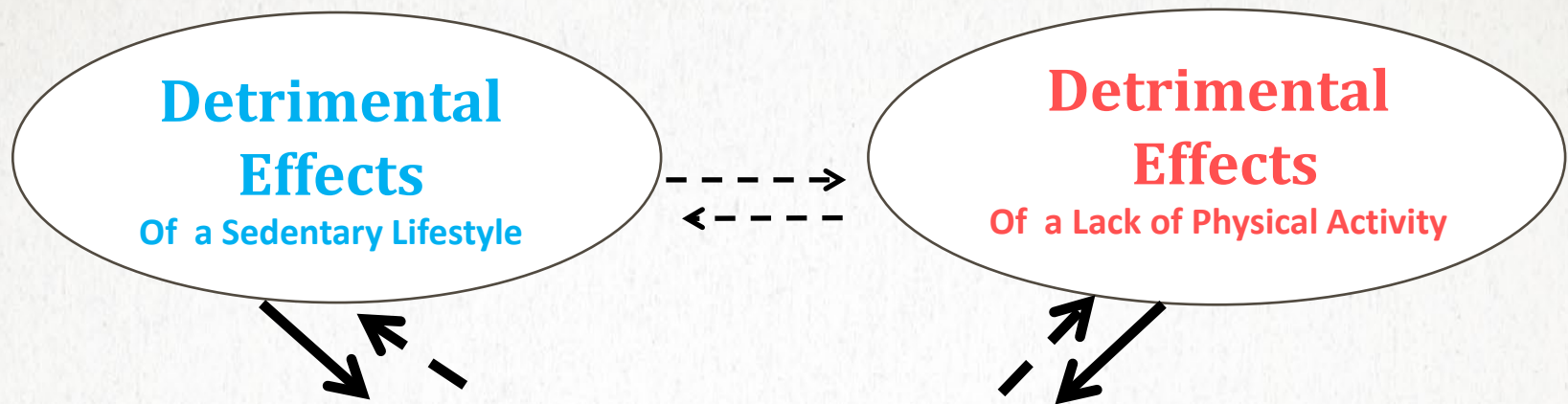
Effect of Diabetes on Neuromuscular Function



Diabetic Periphefal Neuropathy and Neuromuscular Dysfunction



LIFESTYLE



- Increases CV and for all causes Mortality

Sedentary behaviour is an independent predictor of diabetic foot ulcer

development: An 8-year prospective study

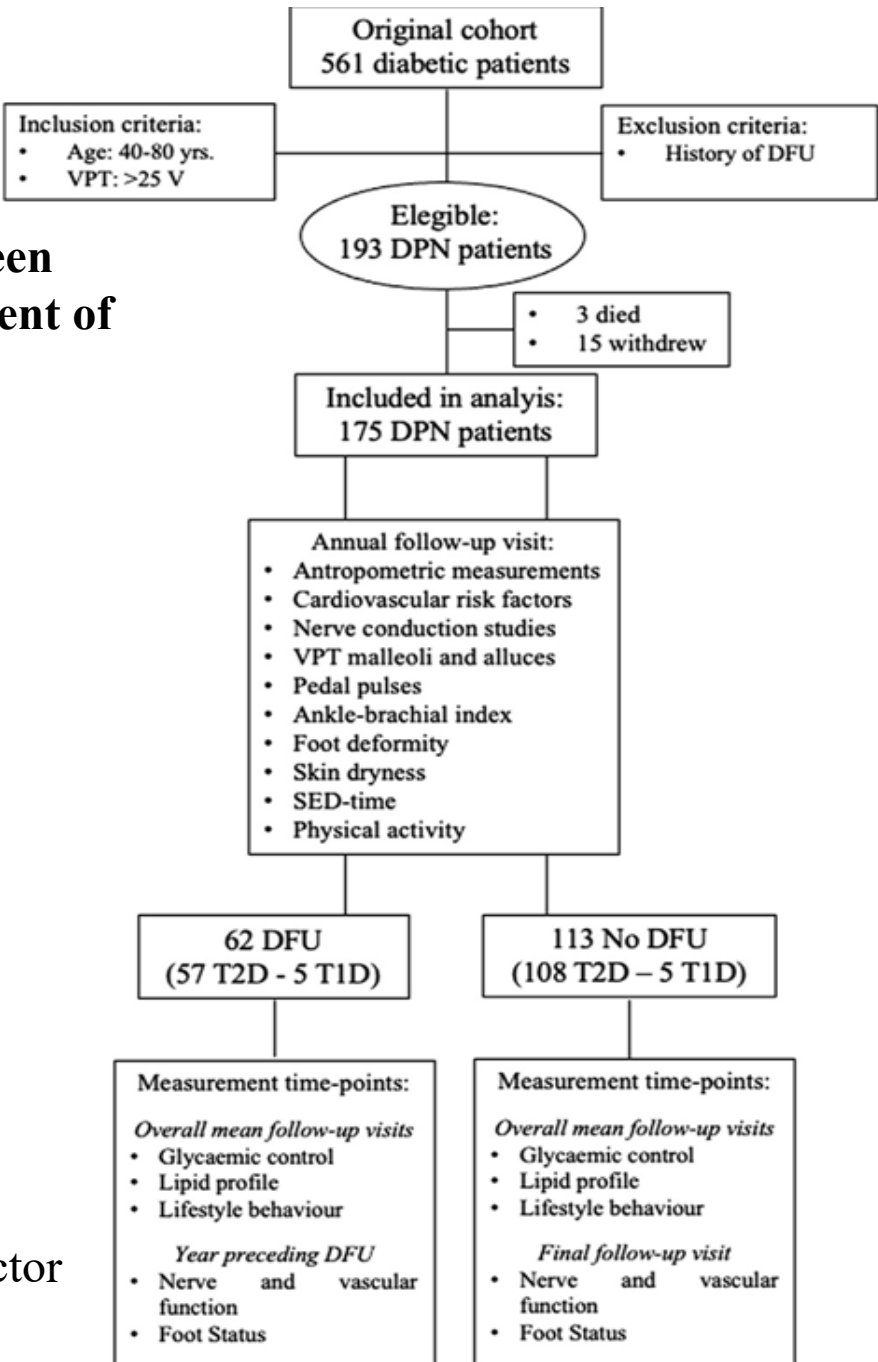
Giorgio Orlando, Neil D. Reeves, Andrew J.M. Boulton, Alex Ireland, Giovanni Federici , Adalberto Federici , Jonida Haxhi , Giuseppe Pugliese ,Stefano Balducci *2021 Jul;177:108877*

Aims

To prospectively explore the association between sedentary time (SED-time) and the development of diabetic foot ulcer (DFU) in people with diabetic peripheral neuropathy (DPN).

Table 2 – Multiple logistic regression analysis of clinical and non-clinical factors associated with the development of DFU.			
History of DFU	OR	95% CI	p values
Model 1			
SED-time	2.95	1.45, 6.44	0.008
Model 2			
Pedal pulses (absent)	2.81	0.12, 0.63	0.002
Model 3			
Deformity (present)	2.63	1.30, 5.32	0.007
Model 4			
Skin dryness (present)	2.04	0.95, 4.37	0.037
Model 5			
PMN amplitude	0.33	0.18, 0.60	<0.001
Model 6			
SSN amplitude	0.85	0.77, 0.94	0.002
Model 7			
Ankle-brachial index (ABI)	0.23	0.1, 0.61	0.001
Model 1, covariates: HbA _{1c} , pedal pulses, SSN amplitude, physical activity; Model 2, covariates: age, diabetes duration, HbA _{1c} , physical activity; Model 3, covariates: BMI, diabetes duration, SSN amplitude, PMN amplitude; Model 4, covariates: age, diabetes duration, HbA _{1c} deformity; Models 5 to 7, covariates: age, diabetes duration, HbA _{1c} , physical activity.			

Conclusions: SED-time is an independent predictor of the risk of DFU in people with DPN.



Sedentary behaviour is an independent predictor of diabetic foot ulcer development: An 8-year prospective study

Giorgio Orlando, Neil D. Reeves, Andrew J.M. Boulton, Alex Ireland, Giovanni Federici , Adalberto Federici , Jonida Haxhi , Giuseppe Pugliese ,Stefano Balducci *2021 Jul;177:108877*



Highlights

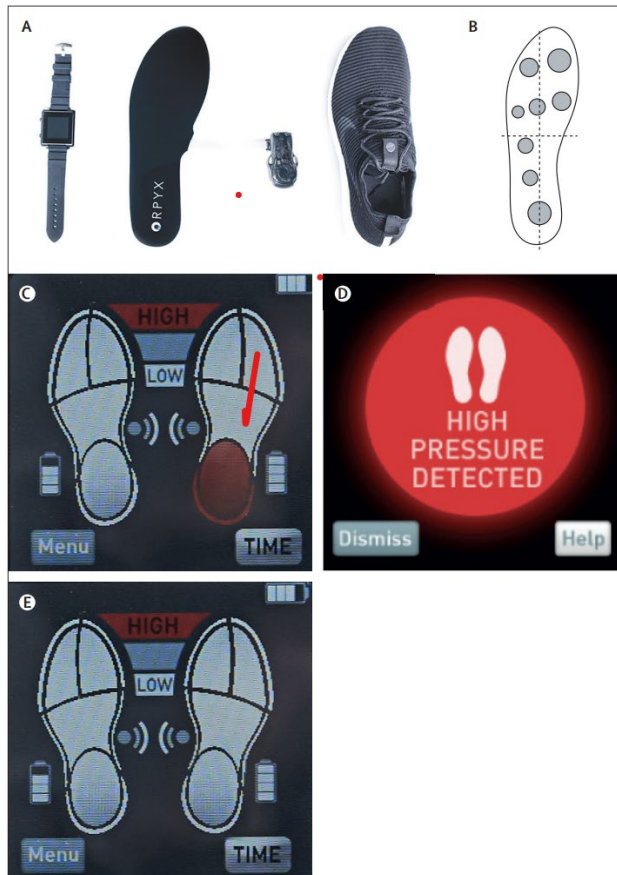
- SED-time is a powerful predictor of risk of foot ulcer in people with DPN
- DPN patients who are likely to develop a foot ulcer spend at least 12 h of sedentary time.
- The monitoring of SED-time should be included in the standard care of diabetic patients and strategies aimed at reducing it remain an unmet necessity.

Innovative intelligent insole system reduces diabetic foot ulcer recurrence at plantar sites: a prospective, randomised, proof-of-concept study

Caroline A Abbott ¹, Katie E Chatwin ², Philip Foden ³, Ahmad N Hasan ⁴, Chandbi Sange ⁵, Satyan M Rajbhandari ⁵, Prabhav N Reddy ⁶, Loretta Vileikyte ⁷, Frank L Bowling ⁸, Andrew J M Boulton ⁷, Neil D Reeves ²

**Lancet Digital Health
2019; 1: e308–18**

**Ulcer incidence was
reduced by 86%**



Plantar callus severity was greater in re-ulcerating patients than non-re-ulcerating patients

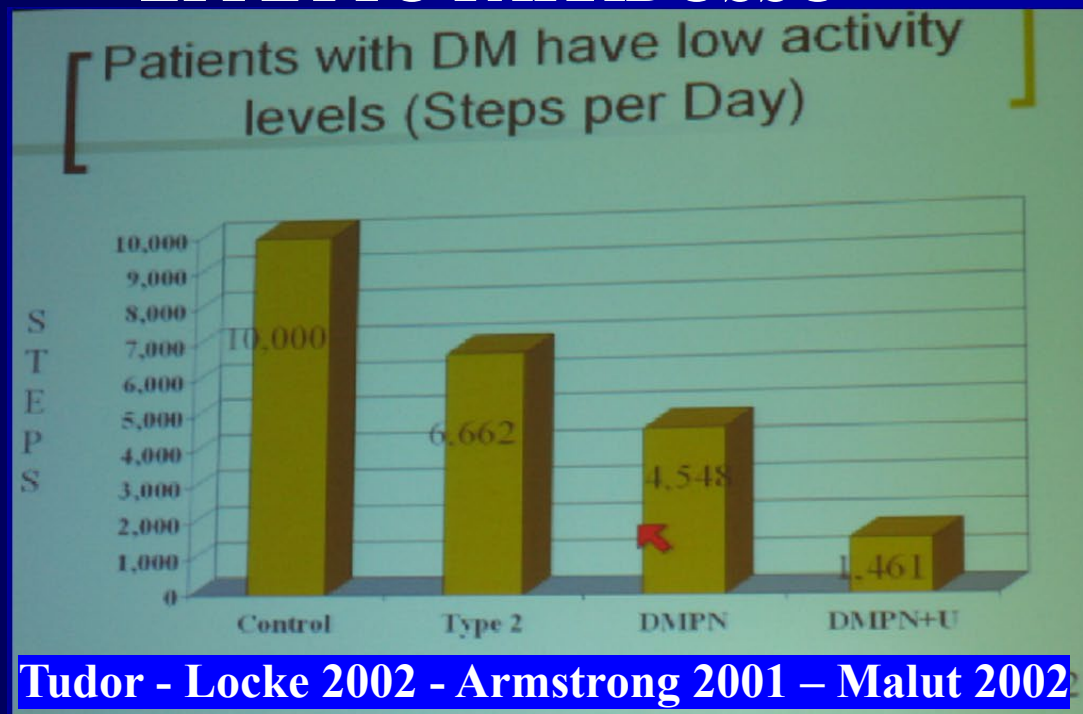
Plantar callus (hyperkeratosis) is caused by excessive mechanical loading and increased plantar pressures due to **foot deformities, limited joint mobility, sensory and autonomic dysfunction**, and is among one of the strongest predictors of foot re-ulceration.

The majority **95% of alerts** occurring while in static activities; eg, sitting working at a computer (with feet tucked under a chair), driving, or standing still for prolonged periods, with regular movement of foot positions to break bouts of sustained pressure successfully stopping the alerts. Only a minority **11%** described ever receiving alerts while walking.

ASSIOMA Attuale

La presenza di DPN, Neuropatia Autonoma, l'ipercarico, le modifiche anatomiche del piede (Cute, Tendini, Ossa), lo shear stress sono alla base dell'ulcerazione e della re-ulcerazione

EFFETTO PARADOSSO



Most active (>7.5 hr/day) were at 80% (13-96%) less risk for skin breakdown compared to least active (<4.5 hr/day)

- 400 participants with DM and hx of ulcer
- daily activity self reported every 17 weeks for 2 years

■ LeMaster et al, Med & Sci Sports & Ex, 2003

L'ulcera compare nei diabetici neuropatici meno attivi -42%. Maggiore variabilità di attività negli ulcerati soprattutto nelle 2 settimane precedenti l'insorgenza dell'ulcera- Armstrong Diabetes Care 2004

La persona diabetica Neuropatica con ulcera pregressa che fa attività si re-ulcera meno della persona che rimane immobile

Durezza cutanea (DMT) nel 1°-III°-V° metatarso dei piedi di pazienti diabetici con neuropatia (ND+) e non (ND-)

242

sono stati suddivisi in due gruppi in base alla presenza 86 (ND+) o all'assenza 156 (ND-) di neuropatia (Tab.2).

	128 (52.9)	ND+	ND-
Physical Activity Lifestyle, n %			
Sedentary	52 (21.5)	27 (31.4)	25 (15.4) ^c
No Sedentary, Physically Inactive	82 (33.9)	32 (37.2)	50 (32.2)
Physically Active	107 (44.2)	27 (31.4)	80 (51.4) ^c

Disfunzione Neuro-Muscolare e Ulcera/amputazione: ruolo dell' Esercizio Fisico nella persona con diabete

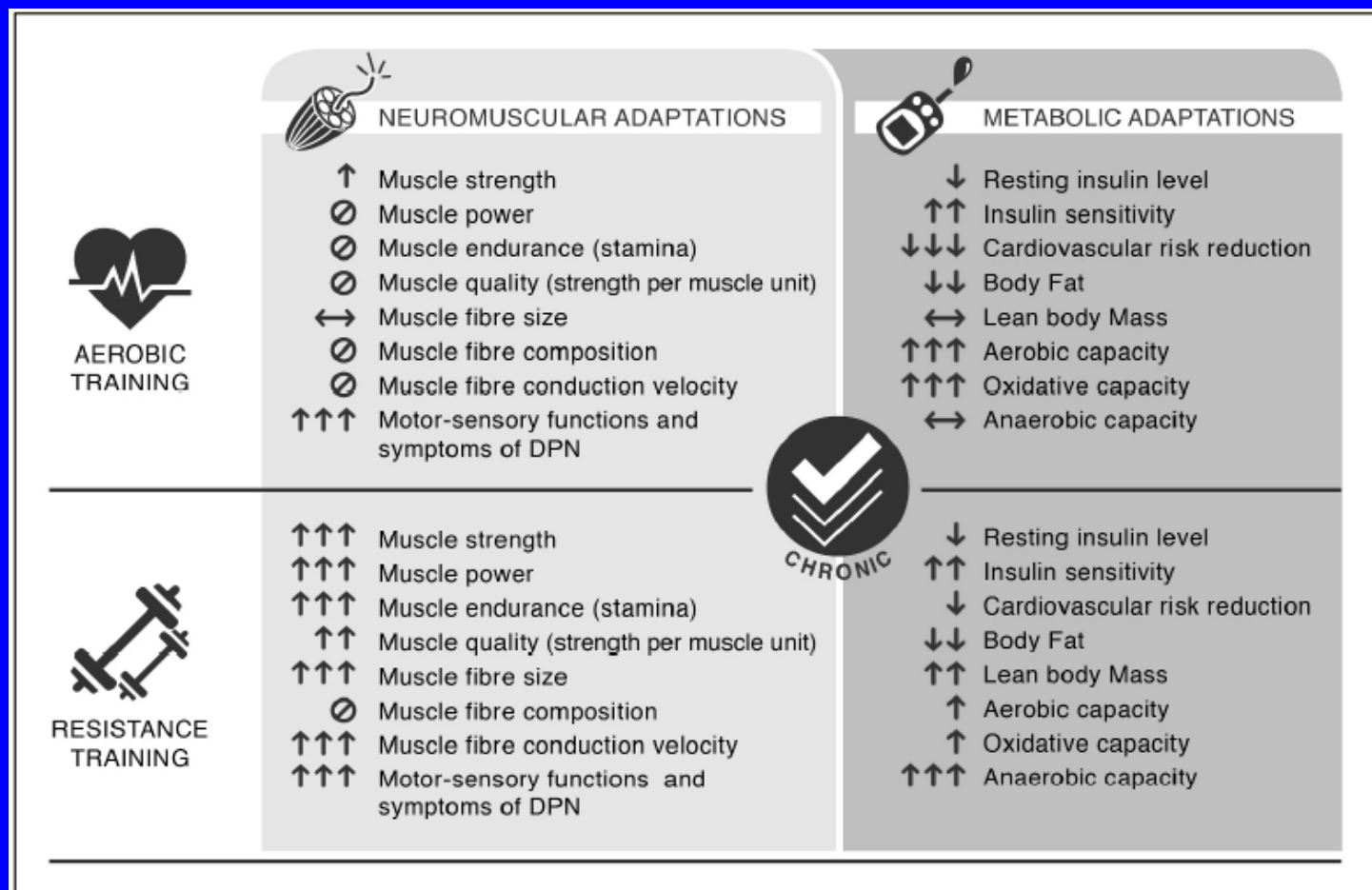
**Può l'esercizio fisico ridurre i fattori di rischio modificabili, contribuire a
prevenire e/o ritardare
la progressione delle alterazioni neuro-muscolari e l' ulcera/amputazione
nel paziente diabetico?**

Exercise in type 2 diabetes: genetic, metabolic and neuromuscular adaptations. A review of the evidence

Silvano Zanuso, Massimo Sacchetti, Carl Johan Sundberg, Giorgio Orlando, Paolo Benvenuti and Stefano Balducci

Br J Sports Med published online May 13, 2017

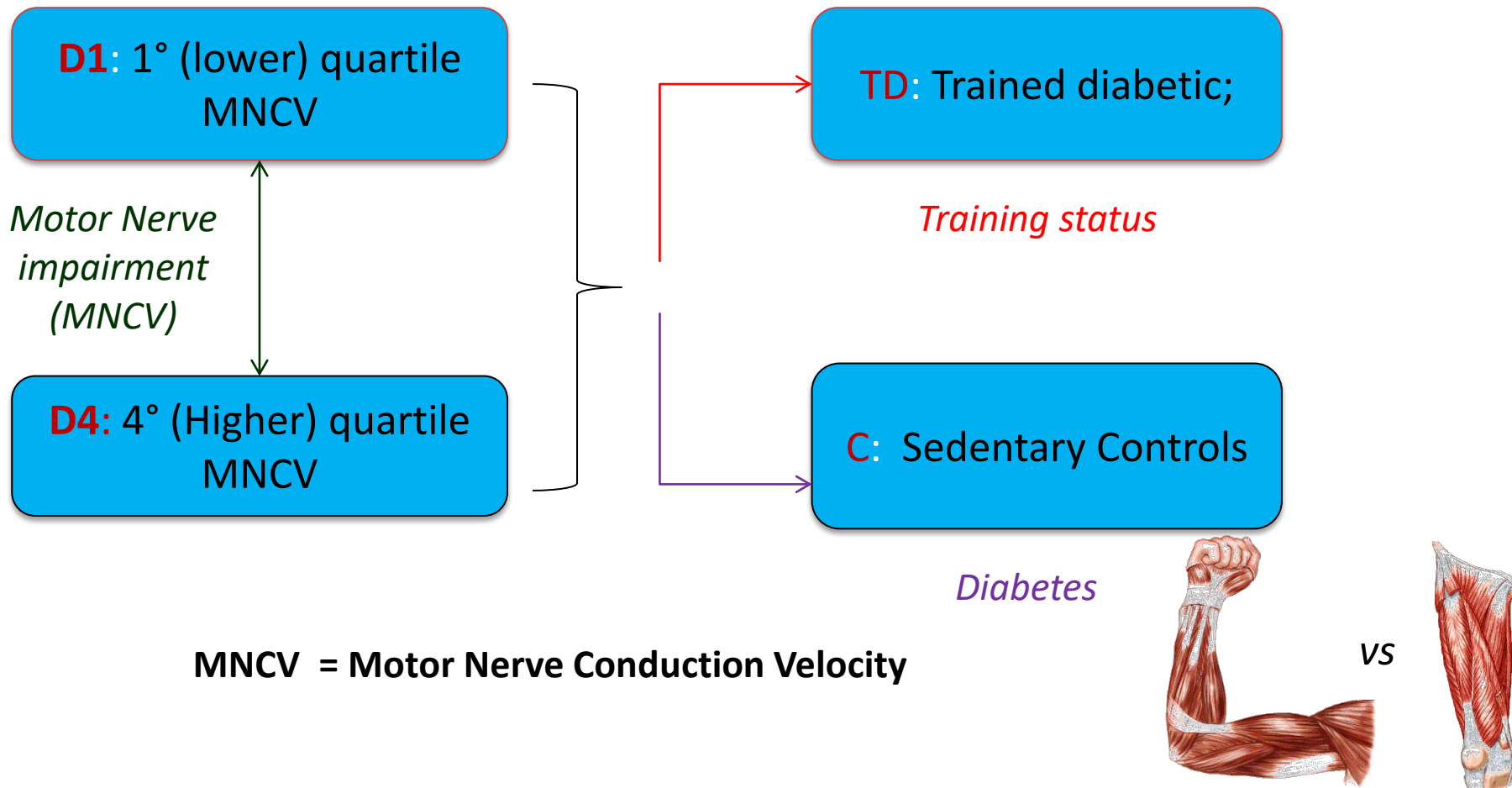
Figure 2 Basic neuromuscular and metabolic chronic modifications induced by aerobic and resistance training ↔, parameter remain unchanged; ↑, small increase; ↑↑, moderate increase; ↑↑↑, large increase; ↓, small decrease; ↓↓, moderate decrease; ↓↓↓, large decrease; Ø, insufficient evidence available. DPN, diabetic peripheral neuropathy.



Neuromuscular Dysfunction in Diabetes: Role of Nerve Impairment and Training Status

MASSIMO SACCHETTI¹, STEFANO BALDUCCI^{2,3}, ILENIA BAZZUCCHI¹, FLAMINIA CARLUCCI¹, ALESSANDRO SCOTTO DI PALUMBO¹, JONIDA HAXHI¹, FRANCESCO CONTI², NICOLINA DI BIASE⁴, EUGENIO ALANDRIELLO⁵, and GIUSEPPE PUGLIESE²

Med. Sci. Sports Exerc., Vol. 45, No. 1, pp. 52–59, 2013



Implicazioni per la pratica

Deficit di forza ad elevate
velocità angolari

**Minore effetto dell'allenamento
sulla forza espressa ad elevate
velocità angolari**

Deficit potenza muscolare



**Allenamento contro-resistenza
con elevate velocità di
movimento
(all. potenza)**



From 500 consecutive diabetic patients admitted in our Department
Type 1 and type 2 diabetic patients without signs and symptoms of DPN and able
to have a 1.6-Km walk distance were enrolled in this study

118 arruolati

68 f, 50 m; age 51.3 ± 14.3 years, duration of diabetes 8.79 ± 6.2 years

59 - CON

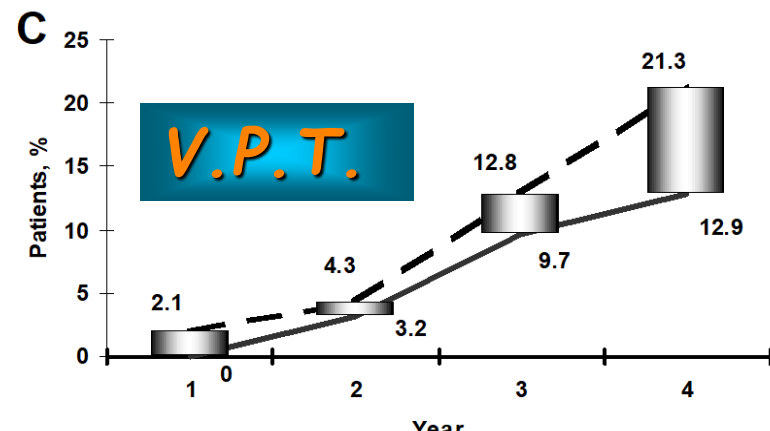
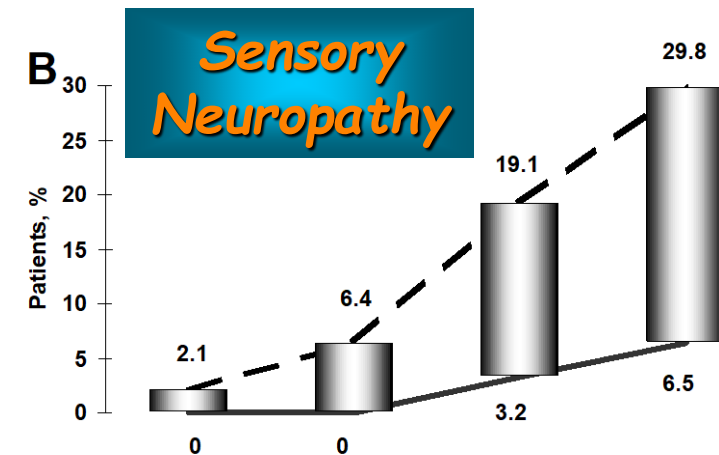
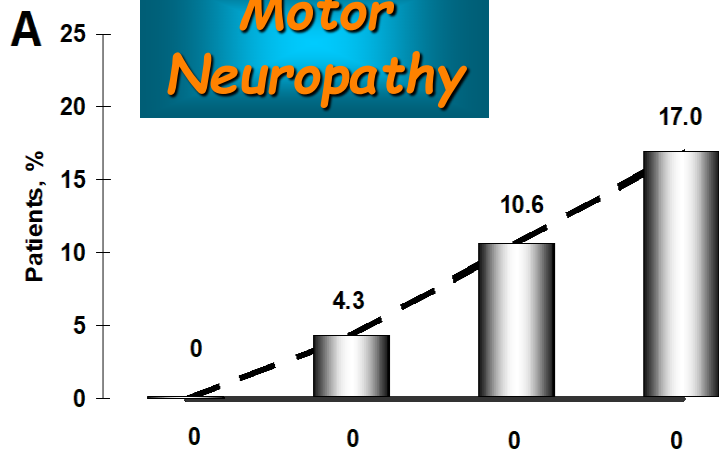
**did not perform supervised
physical activity
for the entire duration
of the study**

59 - EXE

**They performed a prescribed and
supervised 4 hrs pr week (4 sessions pr
week) brisk walking on a treadmill at
50 to 85 % of the heart rate reserve
estimated every month**

**47 diabetic subjects
24 f, 23 m; age 52.9 ± 13.4 yrs;
BMI 30.9 ± 8.4 ;
14 type 1 and 33 type 2
Completano lo studio**

**31 15 f, 16 m; age 49.0 ± 15.5 yrs;
BMI 27.9 ± 4.7 ;
7 type 1 diabetes and 24 type 2
Completano lo studio**



Nei 4 anni dello studio
8 pazienti - 17% CON group
0 EXE group,
Sviluppano motor neuropathy
($p < 0.02$, R , 0.073; 95% CI, 0.003-0.776)

14 - 29.8% CON group
2 - 6.5% EXE group
($p < 0.02$, OR, 0.162; 95% CI, 0.004-1.329)

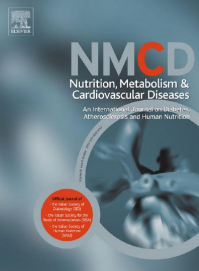
10 - 21.3% CON group
4 - 12.9% EXE group
($p < 0.05$, OR, 0.554; 95% CI, 0.04- 0.97)

Exercise training can modify the natural history of diabetic peripheral neuropathy

S. Balducci et al. / Journal of Diabetes and Its Complications 20 (2006) 216–223

Conclusion

*Our study suggests for the first time
that chronic aerobic exercise may modify
the natural history of DPN*



Anti-inflammatory effect of exercise training in subjects with type 2 diabetes and the metabolic syndrome is dependent on exercise modalities and independent of weight loss

S. Balducci^{a,b,*}, S. Zanuso^c, A. Nicolucci^d, F. Fernando^e, S. Cavallo^f, P. Cardelli^f, S. Fallucca^f, E. Alessi^b, C. Letizia^g, A. Jimenez^h, F. Fallucca^b, G. Pugliese^b

Nutrition, Metabolism & Cardiovascular Diseases (2010) 20, 608–617

82 T2DM (38F/42M)
Age (62.4 ± 7.9 yrs)
Diab. Dur. (8.3 ± 4.3 yrs)
BMI (30.5 ± 5 kg/m²)
Waist (101 ± 13 Cm)
Hba1c (7.8 ± 1.6 %)
Homa-IR (4.3 ± 2.3)

Diabetici di tipo 2 - Sedentari/Fisicamente inattivi Randomizzazione

- A Gruppo di Controllo (Sedentario/Fisicamente inattivo)
- B Aerobico di bassa intensità (<3 Mets)
- C Esercizio Aerobico di intensità vigorosa (>6 Mets)
120 Min.wk/2 sessioni 70-80 % V_{O2} Max (Brisk Walking)
- D Esercizio Aerobico (>6 Mets) + Esercizio di Forza di intensità vigorosa (>3 Mets)
Aerobica = 80' x 2 sessioni x Wk, 70-80% V_{O2} Max
Forza = 40' x 2 sessioni x Wk, 80% 1 RM

X 12 MESI

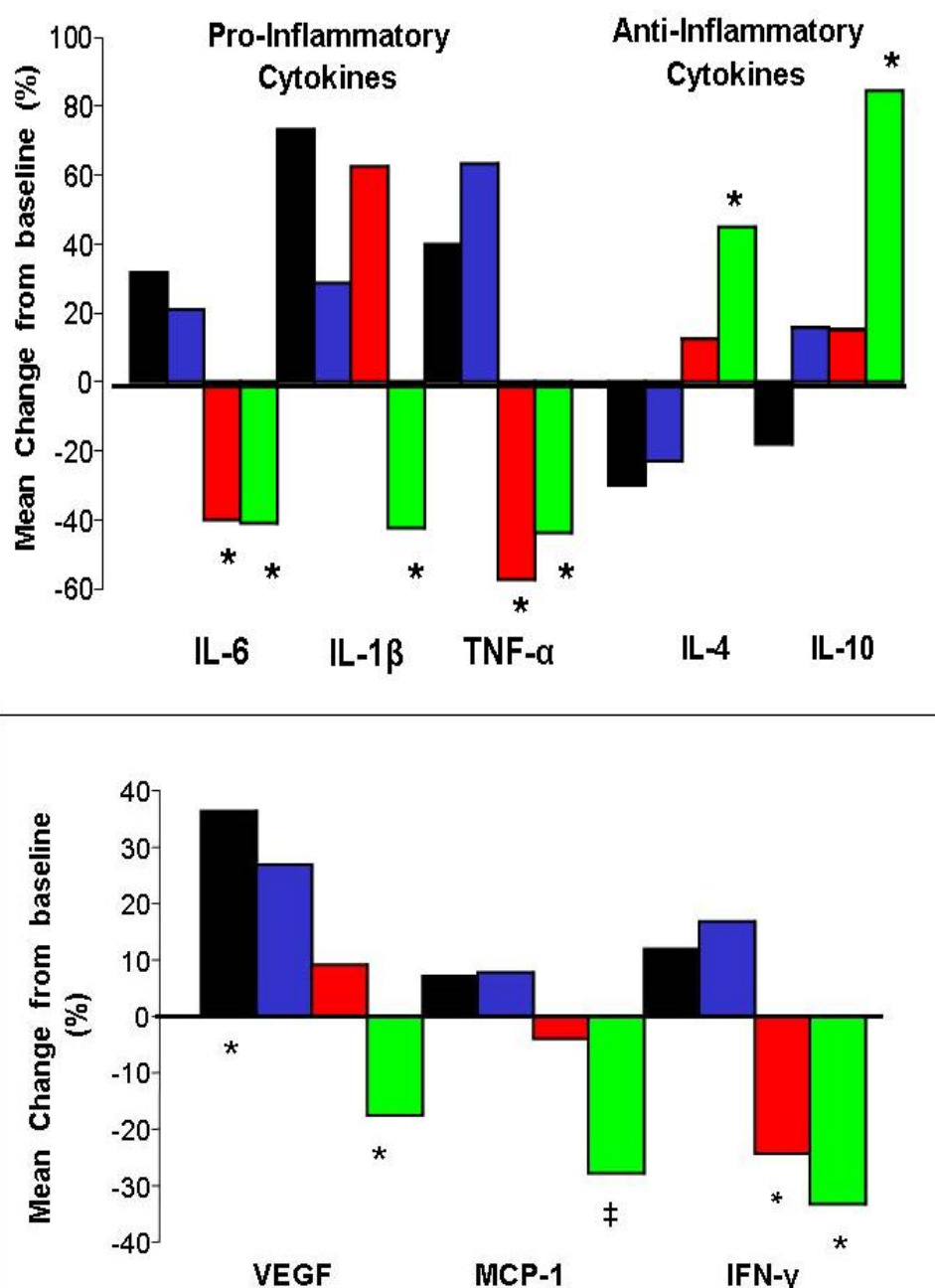
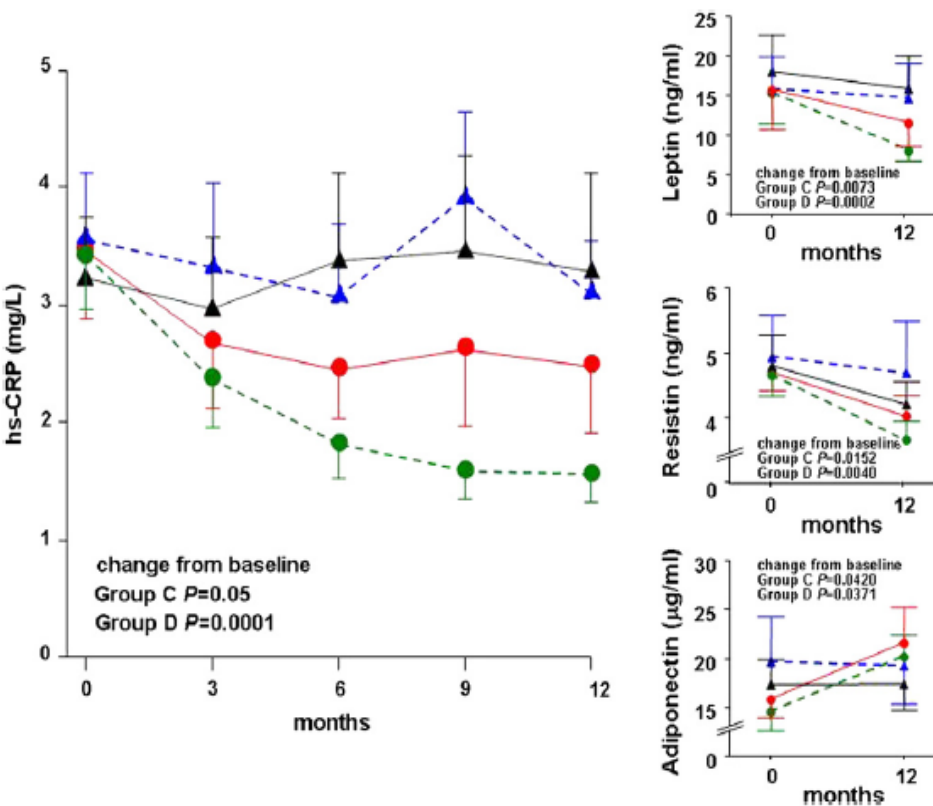
NERO
BLU
ROSSO
VERDE

Gruppo di Controllo (Sedentario/Fisicamente Attivo)

Aerobico di bassa intensità (<3 Mets)

Esercizio Aerobico di intensità vigorosa 120 Min.wk/2 sessioni 70-80 % V_{O2} Max (120 Min.wk/2 sessioni 70-80 % V_{O2} Max)

Esercizio Aerobico (>6 Mets) + Esercizio di Forza (>3 Mets) Aerobica = 80' x 2 sessioni x settimana Forza = 40' x 2 sessioni x settimana



IDES Flow-Chart

606 Patients Randomized to

606 T2DM and
metabolic syndrome

CON Group

n° 303

EXE Group n° 303

Combined (Aerobic+Resistance) progressive exercise program, prescribed and supervised by exercise specialist 150 min/wk in 2 sessions

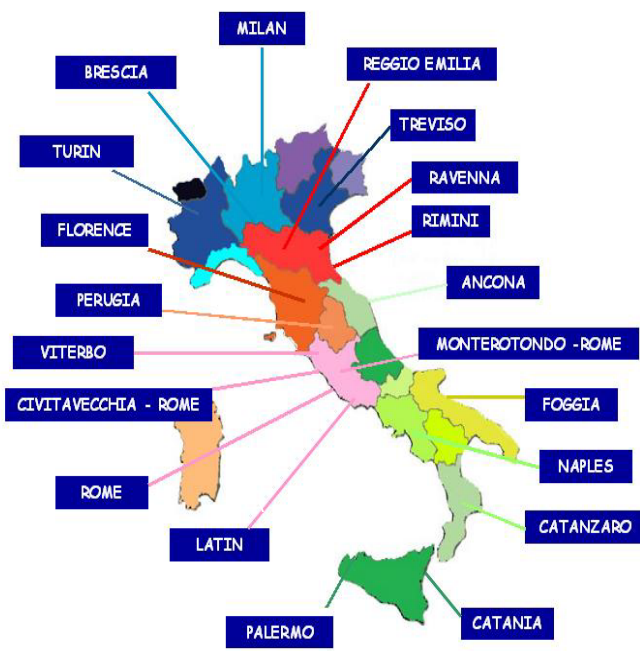
Aerobic

55-70% of VO_{2max}
(Treadmill, step, elliptical, arm cycle ergo meter, Bicycle)

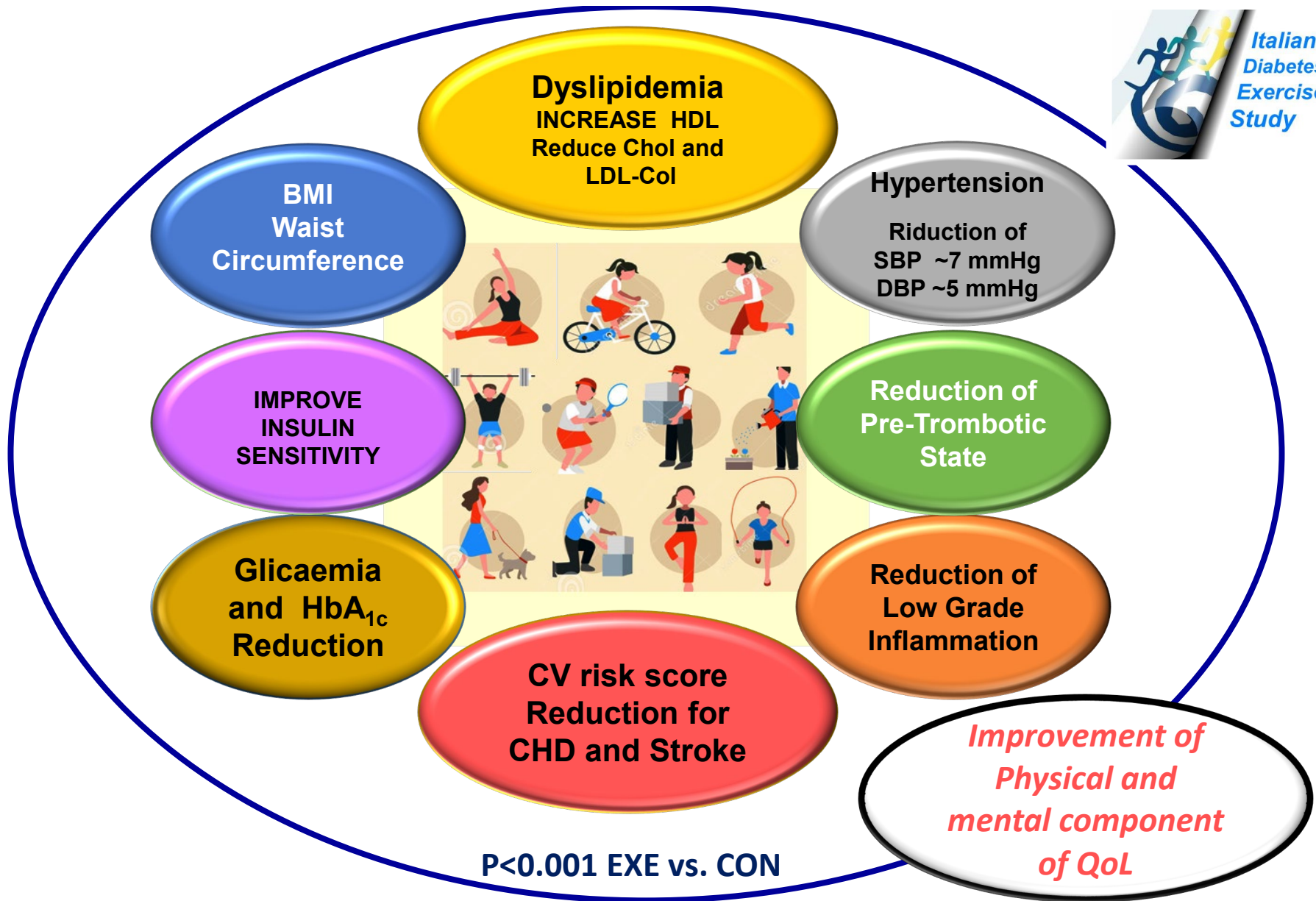
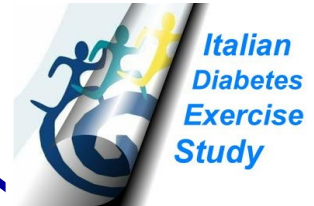
Resistance

60-80% of 1RM
(4 resistance exercises)
chest press, lateral pull down, leg press, trunk flexion for the abdominals, and 3 stretching positions

12
Months



Exercise Training and risk factors



Nicolucci A, Balducci S. et al. Arch Intern Med. 2011, and Diabetologia 2012

Balducci S et al. Arch Intern Med 2010 ; 170:1794-1803

IDES results: Drop out, adherence and safety

606 patients treated for one year

Events	CON	EXE	p value*
A. Related to exercise intervention	20	34	0.06
shoulder pain/chronic tendinopathy or rotator cuff	5	9	
(aggravation of) low back pain	2	6	
aggravation of pre-existing osteoarthritis of hip or knee joint	2	5	
shin splints/lower limb pain	3	7	
other/generalized musculoskeletal discomfort	8	7	
B. Unrelated to exercise intervention	23	25	0.88
1. Elective surgery:	14	13	0.84
arthroscopic knee surgery	1	2	
total thyroidectomy	1	0	
cataract surgery	3	2	
knee/hip joint replacement	1	2	
inguinal hernia	2	1	
varicose vein surgery	1	2	
percutaneous coronary revascularization	2	2	
mastectomy for carcinoma of the mammary gland	2	1	
percutaneous lower limb revascularization	1	1	
2. Other serious medical event:	8	11	0.64
atrial fibrillation	1	1	
newly diagnosed myocardial ischaemia	1	3	
accidental bone fracture	2	3	
bronchitis/pneumonia	3	2	
Otitis	1	2	
3. Death from any cause	1	1	1.00
4. Death from cardiovascular causes	0	0	1.00
Total	43	59	0.10

**28 CON
and 15 EXE
dropped out,
(80,3 % of
completed
supervised
sessions**

Effect of supervised exercise training on musculoskeletal symptoms and function in patients with type 2 diabetes: the Italian Diabetes Exercise Study (IDES)

Balducci S. et IDES Investigators, *Acta Diabetologica* 2014 Feb.

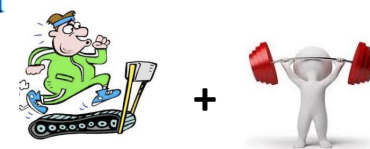


Table 2 Session attendance and PA/exercise volume in EXE subjects with and without musculoskeletal symptoms at baseline

	Patients with symptoms	Patients without symptoms	<i>P</i>
<i>N</i>	238	65	
Total session attendance (%)	80.0	81.4	0.27
Aerobic session attendance (%)	74.6	78.0	0.14
Resistance session attendance (%)	70.6	75.2	0.18
Total PA volume (METs h ⁻¹ week ⁻¹)	19.2 ± 7.5	23.7 ± 9.3	0.19
Supervised exercise volume (METs h ⁻¹ week ⁻¹)	12.1 ± 7.2	16.0 ± 9.6	0.28
Non-supervised PA volume (METs h ⁻¹ week ⁻¹)	7.1 ± 0.7	7.7 ± 0.9	0.33

Values are mean ± SD, unless otherwise specified; *PA* physical activity; *EXE* exercise group

Table 4 Values of scores for symptoms and functional status of upper and lower limb and spine joints at the end of the 12-month study period in the EXE and CON subjects

Score	CON (n = 60)	EXE (n = 60)	<i>P</i>
Constant and Murley Shoulder Outcome Score	0.90 ± 1.3	0.42 ± 0.7	0.03
Roland–Morris Disability Questionnaire	3.1 ± 4.4	2.0 ± 3.3	0.05
Oswestry Disability Questionnaire	3.9 ± 5.1	2.3 ± 3.5	0.01
Harris Hip Score	88.8 ± 16.3	93.5 ± 8.2	0.01
Oxford Knee Score	2.6 ± 5.7	4.2 ± 8.9	0.07

Values are mean ± SD; *CON* control group, *EXE* exercise group

Scores per sintomi e stato funzionale sono risultati significativamente migliori nel gruppo EXE che nel gruppo CON, e correlano con i volumi di attività fisica e i miglioramenti nei parametri di fitness

Italian Diabetes and Exercise Study 2 (IDES_2)

The IDES_2 is an open-label, parallel RCT aimed at assessing the efficacy of a behavioural intervention strategy in increasing total daily PA and reducing SED-time in patients with T2DM

**300 patients with type 2 diabetes
sedentary and physically inactive
received**

Usual Care (Diet, Drugs) and
randomized to

Primary end point

Total daily PA and SED-time

Secondary end points

- physical fitness
- modifiable cardiovascular risk factors
- health-related quality of life (QoI)



INT Group

n = 150

Theoretical counselling session
30 min face-to-face with
Physician Diabetologist
(once a year for three years)



CON Group

n° 150

**For 36
Months**



IDES_2 results: Dropout, adherence

300 Patients treated for 3 years

422 Received behavioral intervention

150 Participants in year 1

143 Participants in year 2

129 Participants in year 3

93,8 % Adherence

17 Lost to follow-up

11,3 %

428 Received standard care

150 Participants in year 1

144 Participants in year 2

134 Participants in year 3

95,1 % Adherence

16 Lost to follow-up

10,7 %

No Ulceration/and Amputation during the 3 years period of intervention

IDES_2 Conclusion

Research

JAMA | **Original Investigation**

Effect of a Behavioral Intervention Strategy on Sustained Change in Physical Activity and Sedentary Behavior in Patients With Type 2 Diabetes The IDES_2 Randomized Clinical Trial

Stefano Balducci, MD; Valeria D'Errico, MD; Jonida Haxhi, MD, PhD; Massimo Sacchetti, PhD; Giorgio Orlando, PhD; Patrizia Cardelli, PhD; Martina Vitale, MD; Lucilla Bollanti, MD; Francesco Conti, MD, PhD; Silvano Zanuso, PhD; Giuseppe Lucisano, StatD; Antonio Nicolucci, MD, PhD; Giuseppe Pugliese, MD, PhD; for the Italian Diabetes and Exercise Study 2 (IDES_2) Investigators

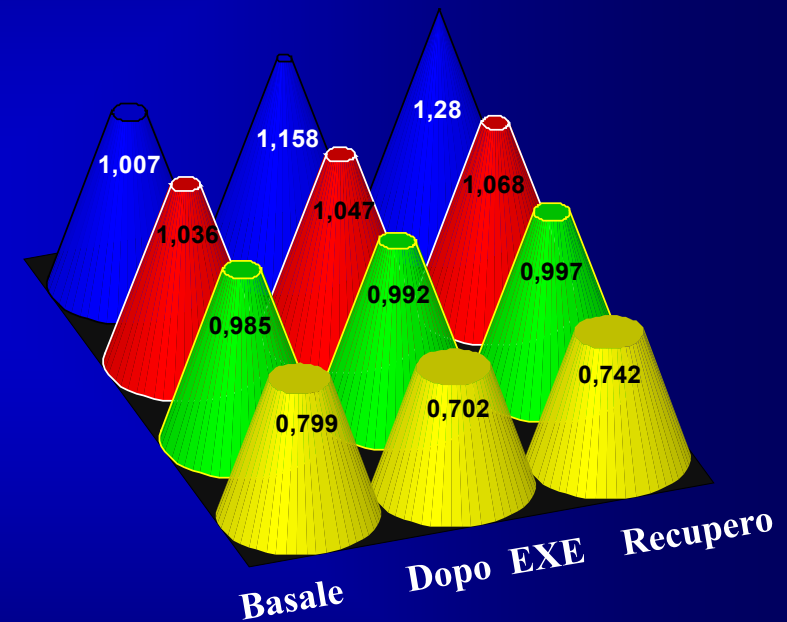
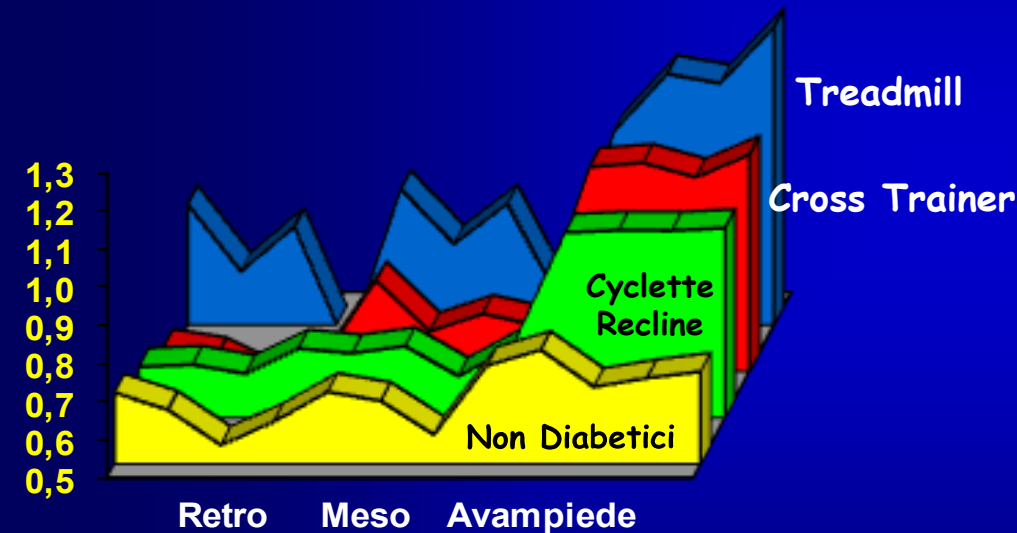
*Among patients with type 2 diabetes followed for 3 years, a behavioural intervention strategy compared with standard care resulted in a **sustained increase in physical activity and decrease in sedentary time,** **associated with increased cardiorespiratory and muscular fitness** **besides improved cardiovascular risk profile and psychological well-being and health-related QoL***

Balducci et al. JAMA. 2019;321(9):880-890

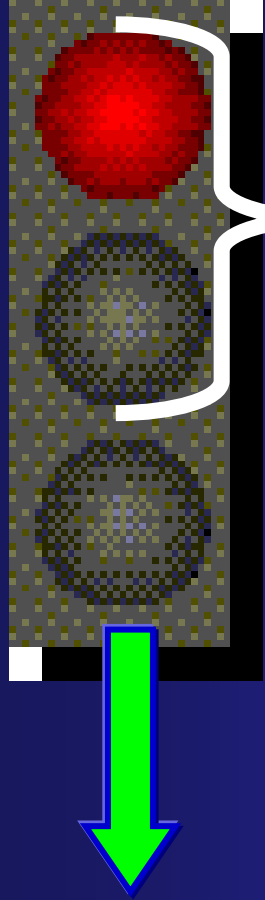
Nel paziente diabetico con DPN gli ipercarichi pressori indotti dall' esercizio fisico sono dovuti a

- Anatomia del piede neuropatico
- Atrofia , Affaticamento muscolare
- Stazione eretta
- Fase di volo del passo

È possibile modulare i carichi pressori avampodalici nei pazienti diabetici con DPN esercitandosi con differenti tipologie di esercizio



- Seduti, (Cyclette Recline)
- Eliminando la fase di volo del passo (Ellittico)
- Distribuendo il lavoro trà muscoli del compartimento anteriore e posteriore della gamba



PRESENZA DI

- Osteoartropatie
- Cattivo Controllo Metabolico

NELLE CONDIZIONI DI

Assenza di background all' esercizio fisico

Sovrappeso

Sedentarietà > 3 mesi

Non completa conoscenza delle condizioni cliniche del paziente

- Piede Diabetico

ASSENZA DI

Osteoartropatie

Complicanze Croniche del Diabete

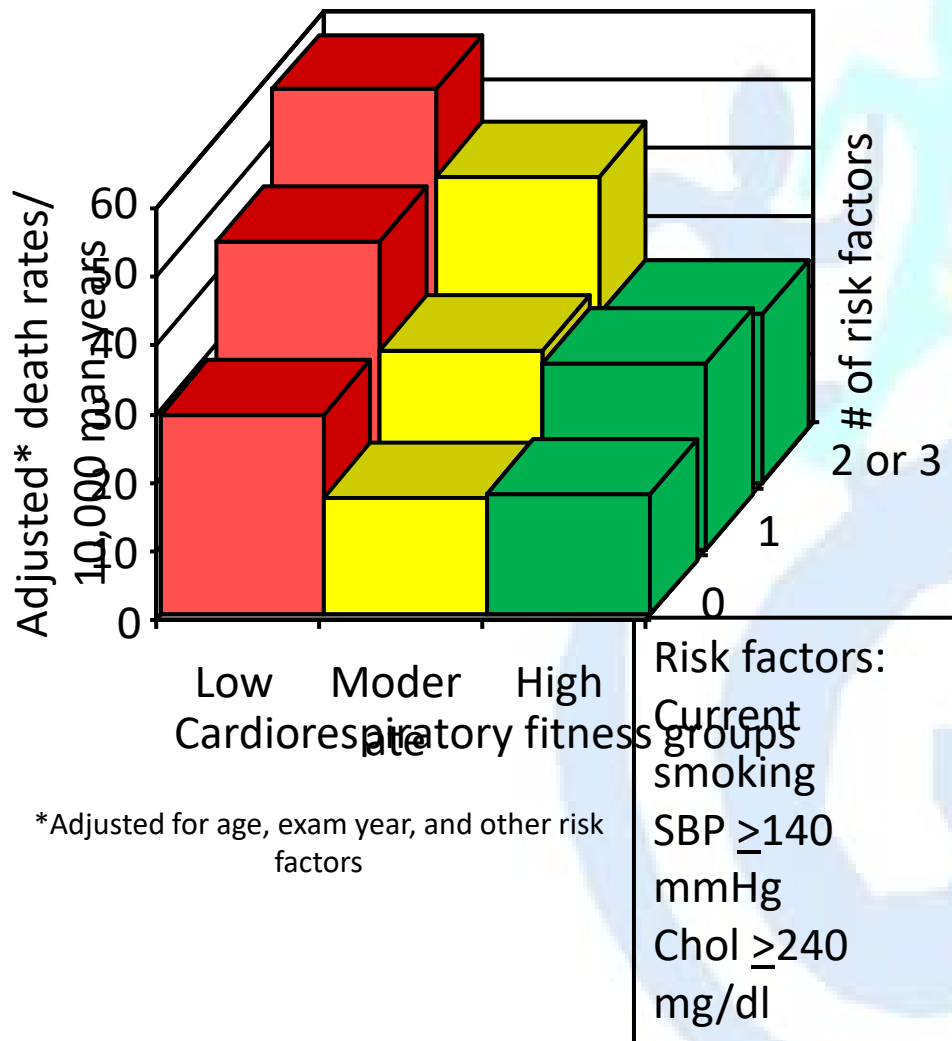
Obesità

Ipertensione

Malattie Cardiovascolari



The Aerobics Center Longitudinal Study (ACLS)



Predictors	All-cause mortality	
	Death rates/10,000 woman-years *	Relative risk †
Low fit	28.8	2.23
Smoking	29.0	2.12
SBP ≥ 140 mmHg	15.1	0.89
Cholesterol ≥ 240 mg/dl	18.9	1.16
BMI ≥ 27 kg/m ²	19.5	1.18

*Adjusted for age and exam year; † compared with those not at risk on that predictor

**Fare esercizio è bello, è salutare per i
muscoli per i nervi per i piedi e per la
persona**

