Mental fatigue in older adults

A narrative review of Subjective, Behavioral, Neurophysiological and Physical changes

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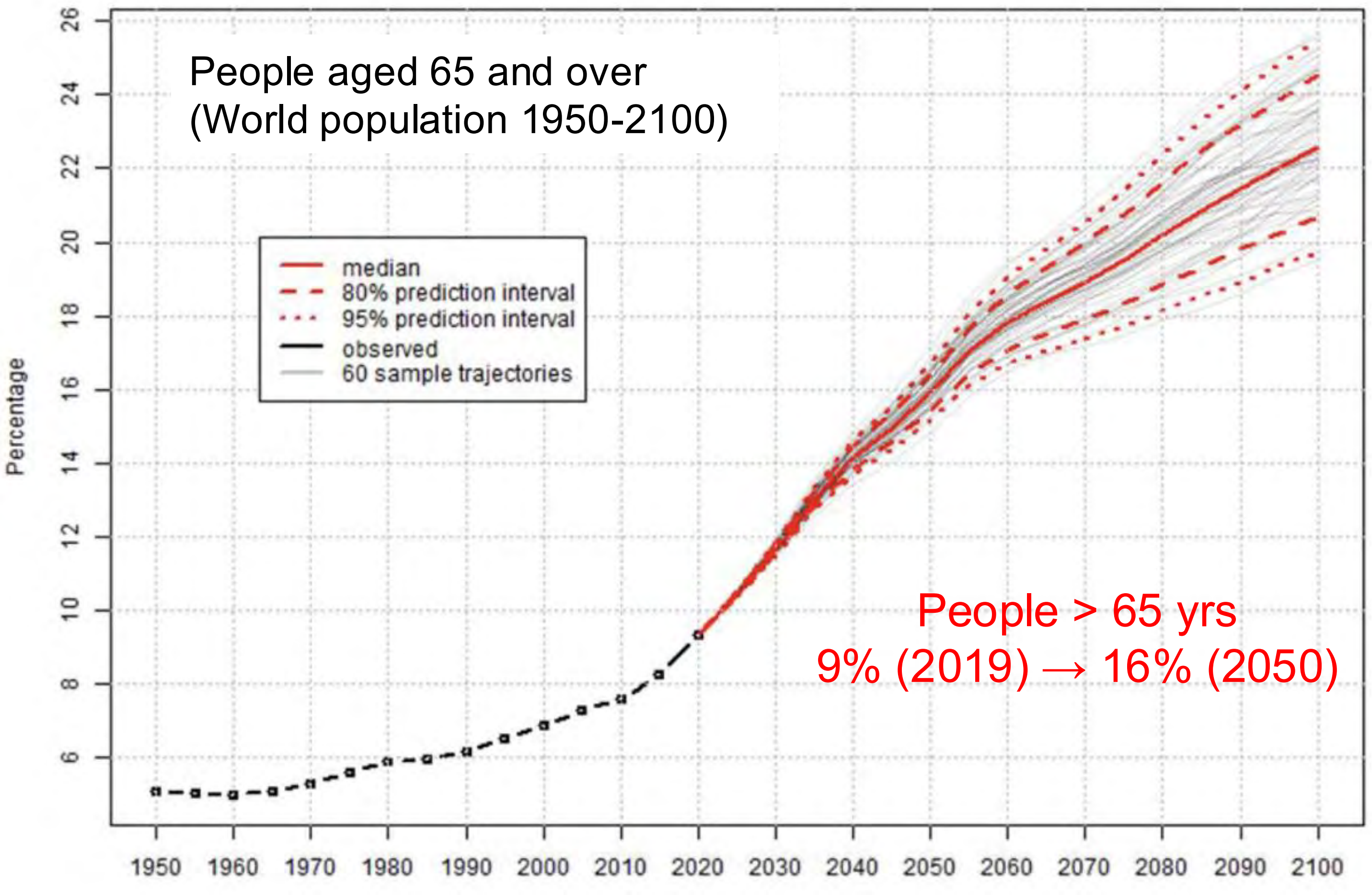
22/10/2025

Context

The population is aging



Aging
Older people → Major Public Health issue

Sandron (2020)

Context

Aging

Progressive process of biological, physiological, and functional changes that occur with age

↘ in adaptive capacities

↗ in vulnerability to diseases and the risk of mortality

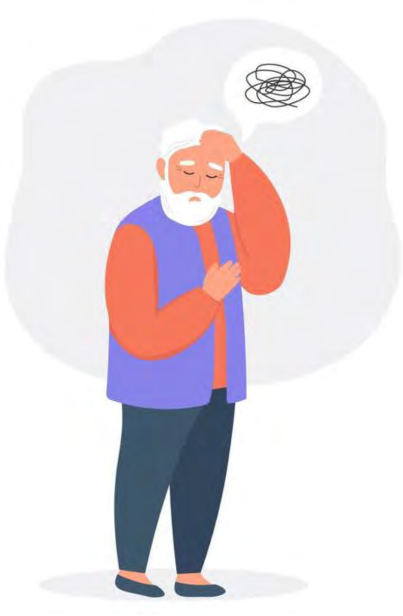
Physical – physiological changes
↘ in maximal strength ↘ in muscle mass ↘ in cardiorespiratory capacities

Cognitive changes
↘ in processing speed ↘ in working memory ↘ in executive functions

Context

One of most common symptom is **Mental Fatigue**

Meng et al. (2010)



Mental fatigue

A **psychobiological state** induced by prolonged and/or intense **cognitive task** performance, characterized by a subjective feeling of **exhaustion** and **lack of energy**

Boksem & Tops (2008)

What are the effects of mental fatigue in older people ?

What are the effects of mental fatigue in older people ?

- Subjective changes
- Behavioral changes
- Neuromuscular changes
- Balance changes
- The role of physical activity

Subjective changes following a cognitive task

N = 20
(66.6 ± 3.4 yrs)

Red	Red
Yellow	Green
Blue	Blue
Green	Red
Green	Blue
Yellow	Green
Blue	Yellow

30 min Stroop task

	Control group		Experimental group	
	Pretest	Posttest	Pretest	Posttest
VAS	10.23 (3.41 mm)	11.71 (4.73 mm)	9.35 (4.18 mm)	68.82* (14.55 mm)

VAS visual analogue scale; *$p \leq .01$

Perceived level of mental fatigue before and after Stroop task or watching documentary program (0 mm = "No mental fatigue"; 100 mm = "Highest mental fatigue").

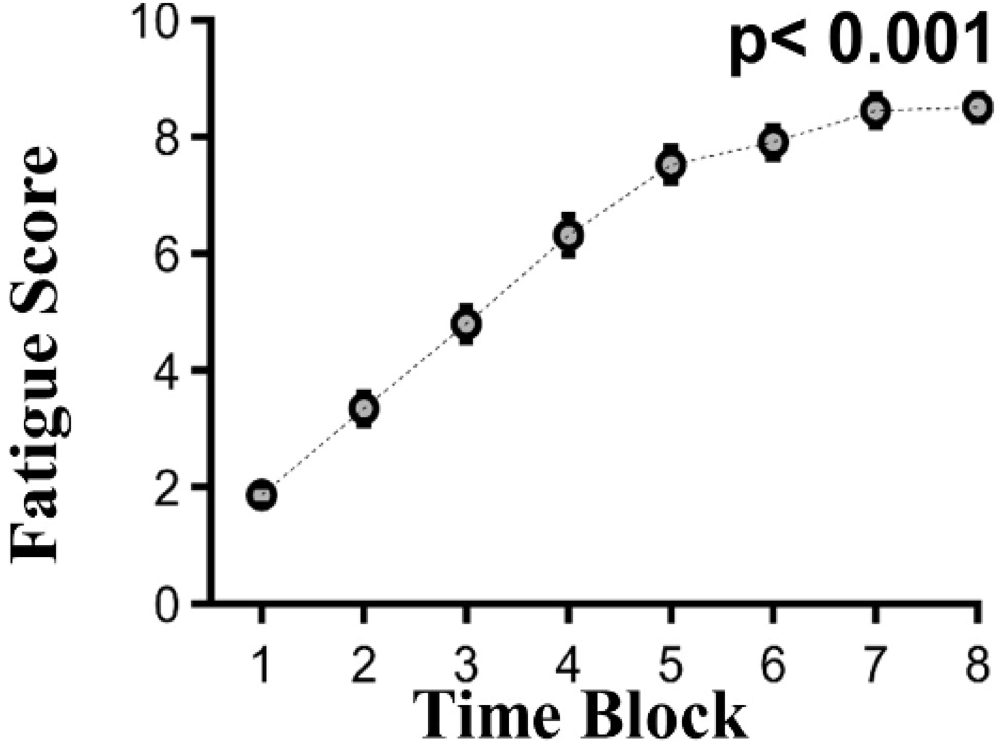
↗ Perceived Mental Fatigue

Nikooharf Salehi et al. (2022)

Subjective changes following a cognitive task

N = 35
(73.8 ± 5.9 years)

160 min Stroop task



Subjective fatigue score by 20-min time blocks

↗ Perceived Mental Fatigue

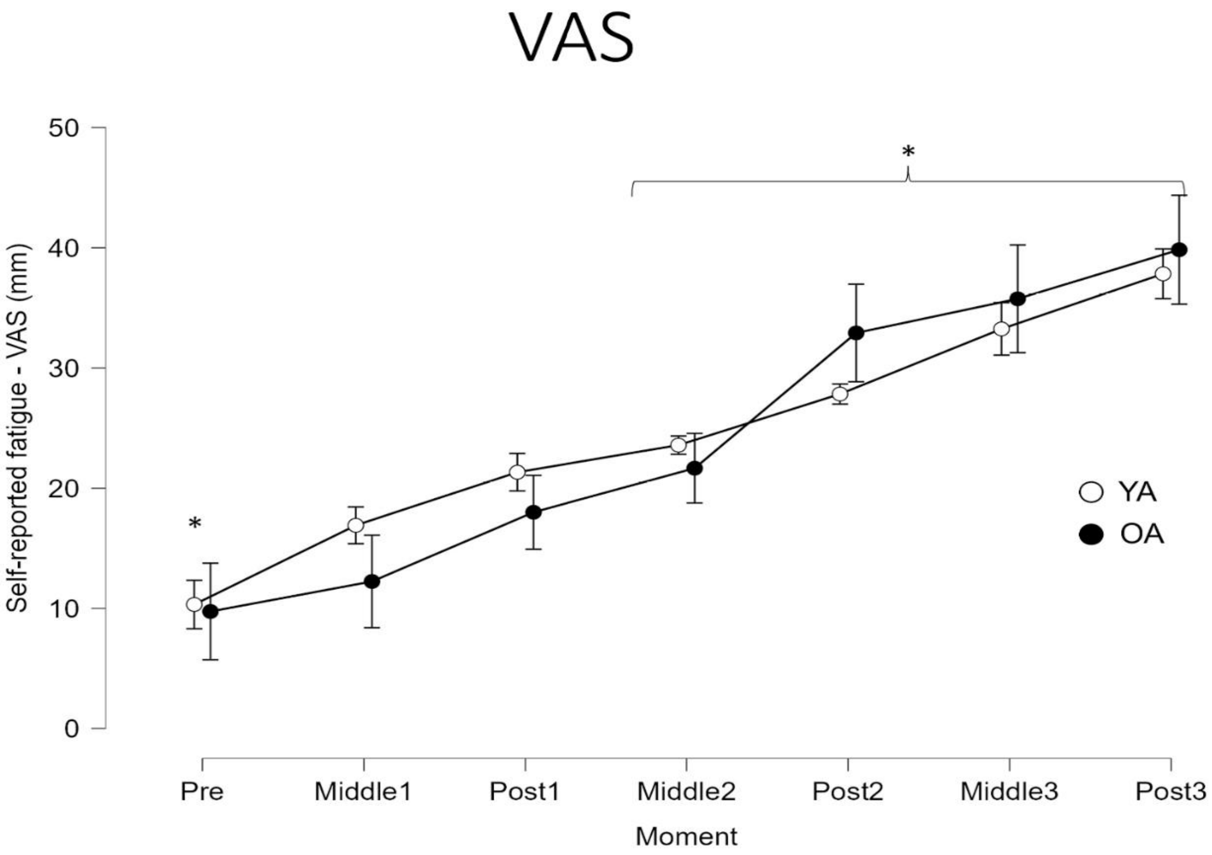
Burke et al. (2018)

Subjective changes following a cognitive task

N = 12
(71.0 ± 3.8 yrs)

30 min Task

PVT
+
AX-CPT
+
Stroop task



Santos et al. (2025)

Perceived Mental Fatigue + in older adults

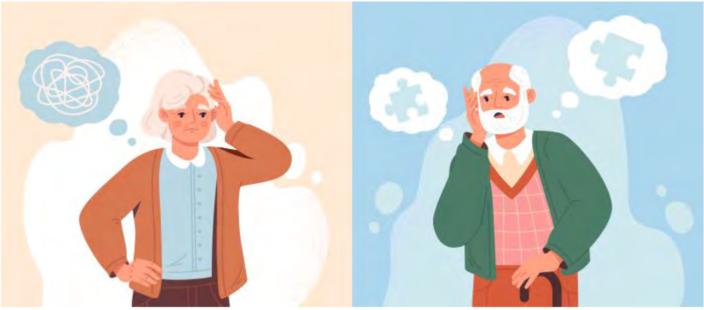
Subjective changes following a cognitive task

Synthesis of the Literature

N = 19

Cognitive task
Stroop, Dual N-back, flanker, PVT, …

Task duration
20 min – 180 min



Behavioral changes following a cognitive task

Behavioral measures

Reaction time (RT)

Accuracy

N = 22 studies

4 different behavioral patterns

Behavioral changes following a cognitive task

≈ RT / ≈ Accuracy → ≈ Behavioral performance

N = 35

Table 1. Performance comparison between CNTR and MF conditions on the stroop test used for manipulation check.

	Pre				Post			
	CNTR	MF	*p*	Effect Size	CNTR	MF	*p*	Effect Size
Accuracy (%)								
Whole Trials	100 (1.6)	100 (1.6)	.36	0.03	99.20 (1.6)	100 (1.6)	.57	0.76
CONG	100 (0)	100 (0)	.48	0.09	100 (0)	100 (0)	.36	0.11
INC	100 (2.3)	100 (2.3)	.24	0.07	100 (2.3)	100 (2.3)	.32	0.08
Response Time (ms)								
Whole Trials	946.7± 185.2	942.9± 181.4	.83	0.02	902.85± 177.3	885.6± 142.3	.31	0.11
CONG	921.2± 180.7	921.4± 201.4	.99	−0.01	893.6± 173.8	864.4± 145.6	.13	0.18
INC	1009± 212.2	998.2± 198.5	.6	0.05	952.8± 204.5	928.7± 167.5	.27	0.13

Note. Legend: Mean and standard deviation were used as central and variability measures for the response time and median and interquartile range were used for accuracy; ms, milliseconds; CNTR, control; MF, mental fatigue; INC, incongruent; CONG, congruent.

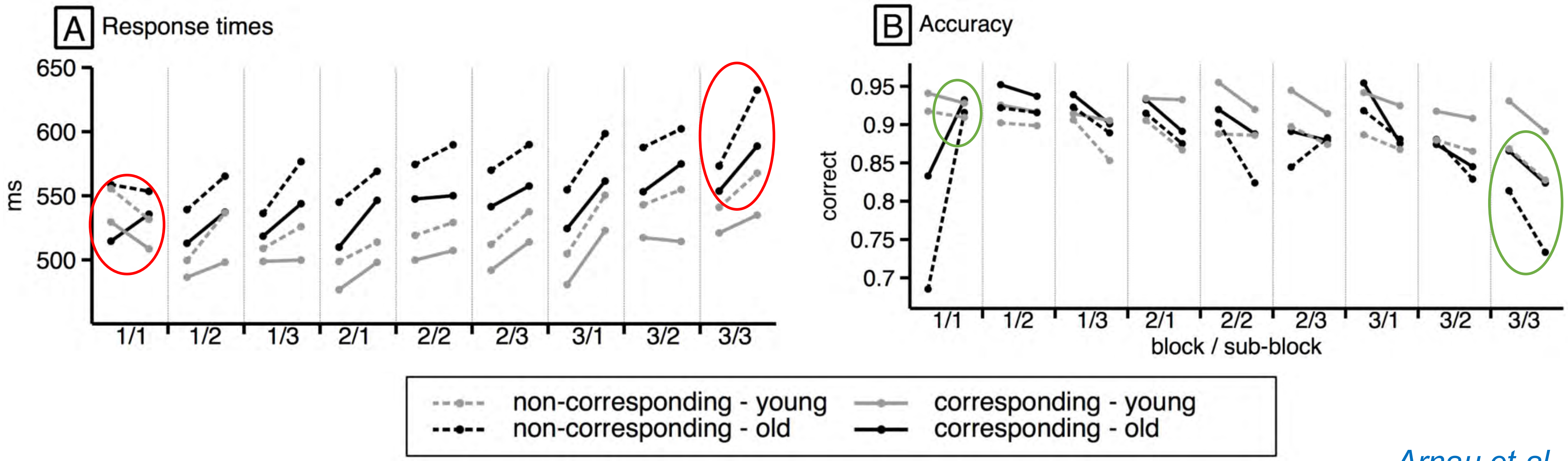
Faria et al. (2024)

Behavioral changes following a cognitive task

↗ RT / ↘ Accuracy → ↘ Behavioral performance

N = 14
64.0 yrs (56-70)

Prolonged visual stimuli task



Arnau et al. (2017)

Behavioral changes following a cognitive task

↗ RT / ≈ Accuracy → ↘ Behavioral performance

N = 12
(71.0 ± 3.8 yrs)

30 min Task

PVT
+
AX-CPT
+
Stroop task

Cognitive performance before (M1) and after (M2) mental fatigue.

Variables	Group	M1	M2	P-Value Group	Time	Group by Time
Reaction Time (s)						
PVT	YA	231.68 ± 34.44	244.15 ± 23.11	**0.033**	**<0.001**	0.203
	OA	256.02 ± 37.78	281.05 ± 41.85			
Stroop – Congruent	YA	611.43 ± 91.45	725.71 ± 108.1	**<0.001**	**0.008**	0.594
	OA	965.01 ± 214.14	1130.87 ± 420.33			
Stroop – Incongruent	YA	632.35 ± 97.8	807.43 ± 145.36	**<0.001**	**0.01**	0.712
	OA	1127.92 ± 286.76	1261.84 ± 514.4			
AX-CPT	YA	306.16 ± 71.35	302.22 ± 66.89	**0.046**	*0.053#*	0.142
	OA	395.02 ± 125.22	370.35 ± 93.93			
Accuracy (%)						
Stroop – Congruent	YA	94.93 ± 4.32	95.66 ± 4.99	0.134	0.189	**0.038**
	OA	99.08 ± 1.49	96.07 ± 4.81			
Stroop – Incongruent	YA	95.84 ± 5.75	90.77 ± 11.85	0.893	*0.057#*	0.93
	OA	96.11 ± 8.41	91.47 ± 14.01			
AX-CPT	YA	89.59 ± 9.36	92.39 ± 5.06	0.066	0.232	0.391
	OA	80 ± 19.05	80.47 ± 17.58			

Values are mean ± SD. AX-CPT: Continuous Performance Task; M1 and M2: Moments 1 and 2 (initial vs. Last minutes) of the mental tasks before and after mental fatigue; OA: older participants; PVT: Psychomotor Vigilance Task; YA: Young participants.

Santos et al. (2025)

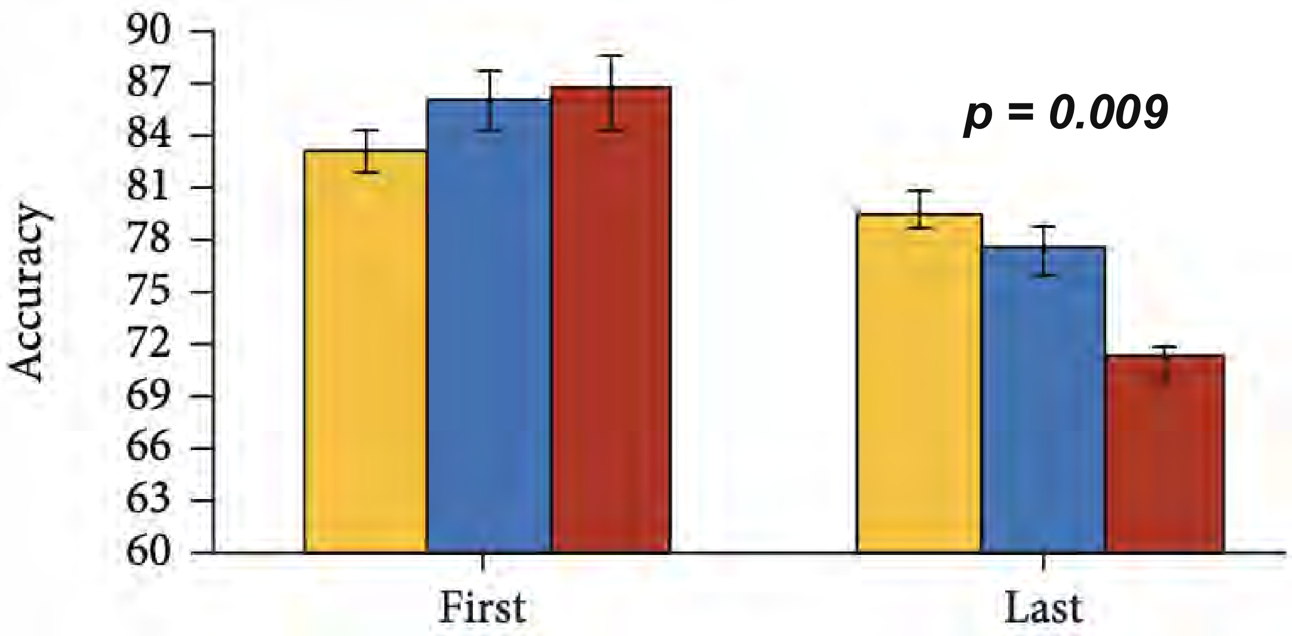
Behavioral changes following a cognitive task

≈ RT / ↘ Accuracy → ↘ Behavioral performance

N = 16
62.1 years
(52-69 yrs)

N-Back task

- 1-Back
- 2-Back
- 3-Back



Pergher et al. (2021)

Behavioral changes following a cognitive task

Synthesis of the Literature

N = 14

Performance ≈ (n = 6)

Task duration = 7 – 180 min

Performance ↘ (n = 8)

Task duration = 30 – 180 min

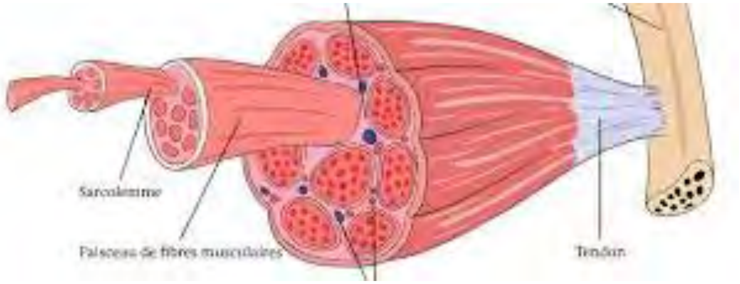
Neuromuscular changes following a cognitive task

N = 16
74 ± 6 years

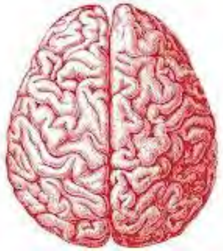
PVT Task (20 min)

↘ Maximal Strength

Morris et al. (2020)



Muscle contractile property or neuromusular excitability



?

Supraspinal mechanism

Trend toward increased cortical inhibition after mental fatigue.

Neuromuscular changes following a cognitive task

≈ Muscular Endurance

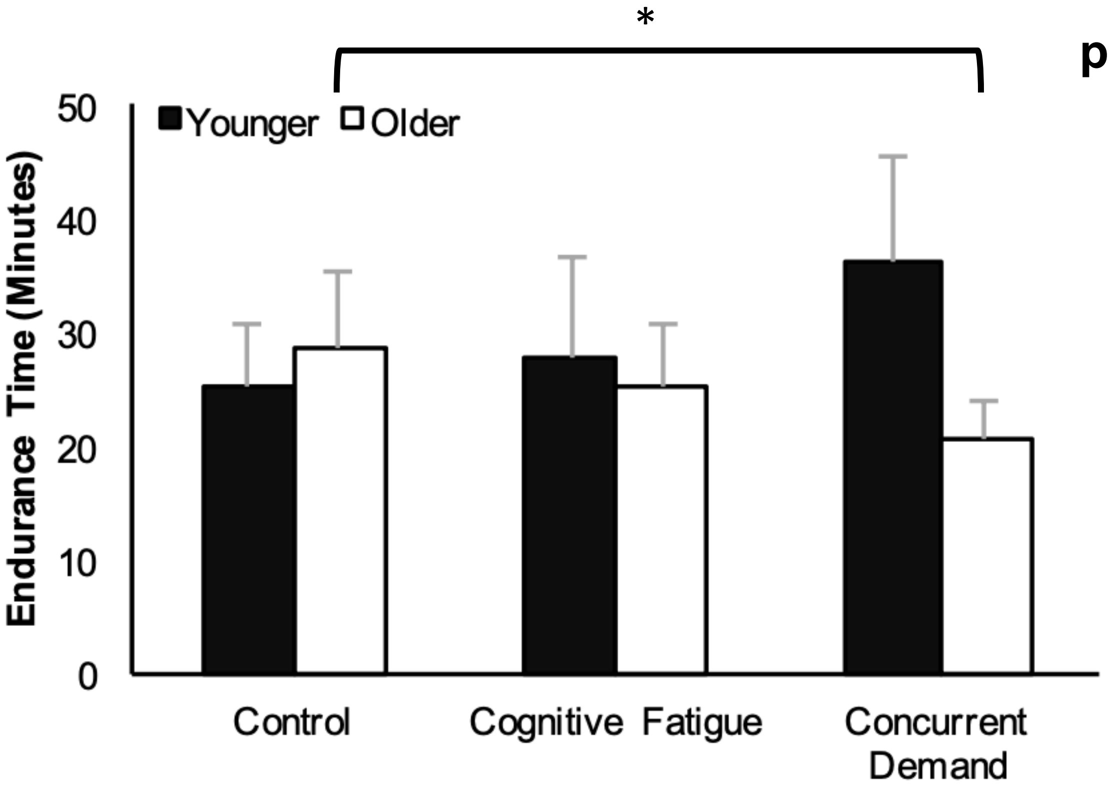
Faria et al. (2024)
n = 35 (N.A)
Task = Flanker + Stroop
Task duration = 50 min

Shortz et al. (2015)
n = 11 (78.8 ± 7.4 years)
Task = Stroop + Dual 1-Back
Task duration = 60 min

Shortz et al. (2017)
n = 10 (75.9 ± 7.8 years)
Task = Stroop + Dual 1-Back
Task duration = 60 min

But …

Neuromuscular changes following a cognitive task



p = 0.03

Double task

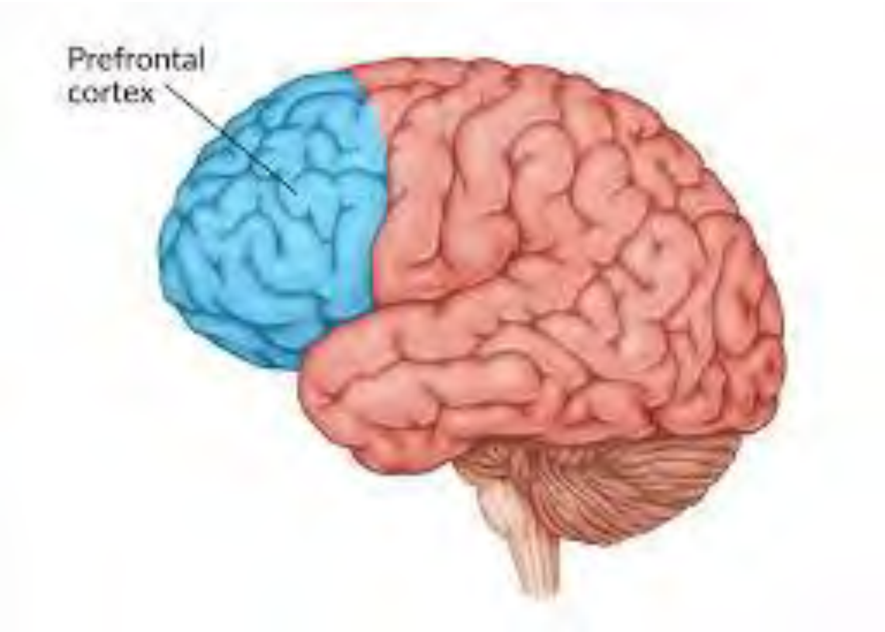
+

-7

↘ Muscular Endurance

Shortz et al. (2017)

Prefrontal cortex activity changes after a cognitive task



Prefrontal cortex activity
↘ with Mental Fatigue

Shortz et al. (2015)
n = 11 (78.8 7.4 years)
Task = Stroop + Dual 1-Back
Task duration = 60 min

Terentjieviene et al. (2018)
n = 15 (72.7 5.7 years)
Task = Go/ Nogo
Task duration = 120 min

Mental Fatigue induces Cortical changes in Older adults

Old ≠ Young ?

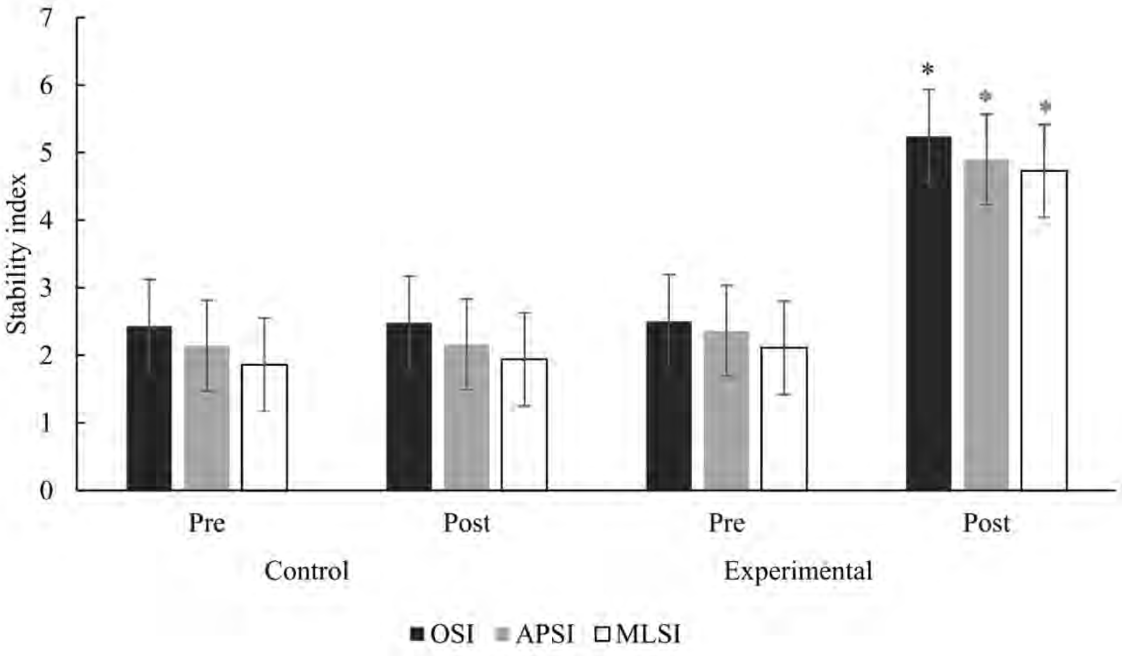
Balance changes after cognitive task ?

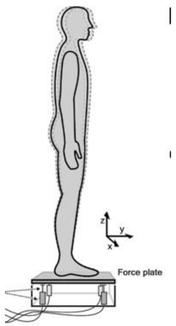
Postural Sway

N = 20
66.6 ± 3.4 yrs

30 min
Stroop Task duration

OSI overall stability index
APSI anterior/posterior stability index
MLSI medial/lateral stability index





Mental Fatigue
⇕
↗ Postural sway

Nikooharf Salehi et al. (2022)

Balance changes after cognitive task ?

Walking biomechanical parameters

N = 12
(71.0 ± 3.8 years)

30 min Task = PVT + Stroop

Results

- ↘ stand time and stride length
- ↗ cadence and variability of stride length

Mental fatigue changes walking biomechanics

Santos et al. (2025)

The role of physical activity

Recent study (López-Rodriguez et al. 2025)

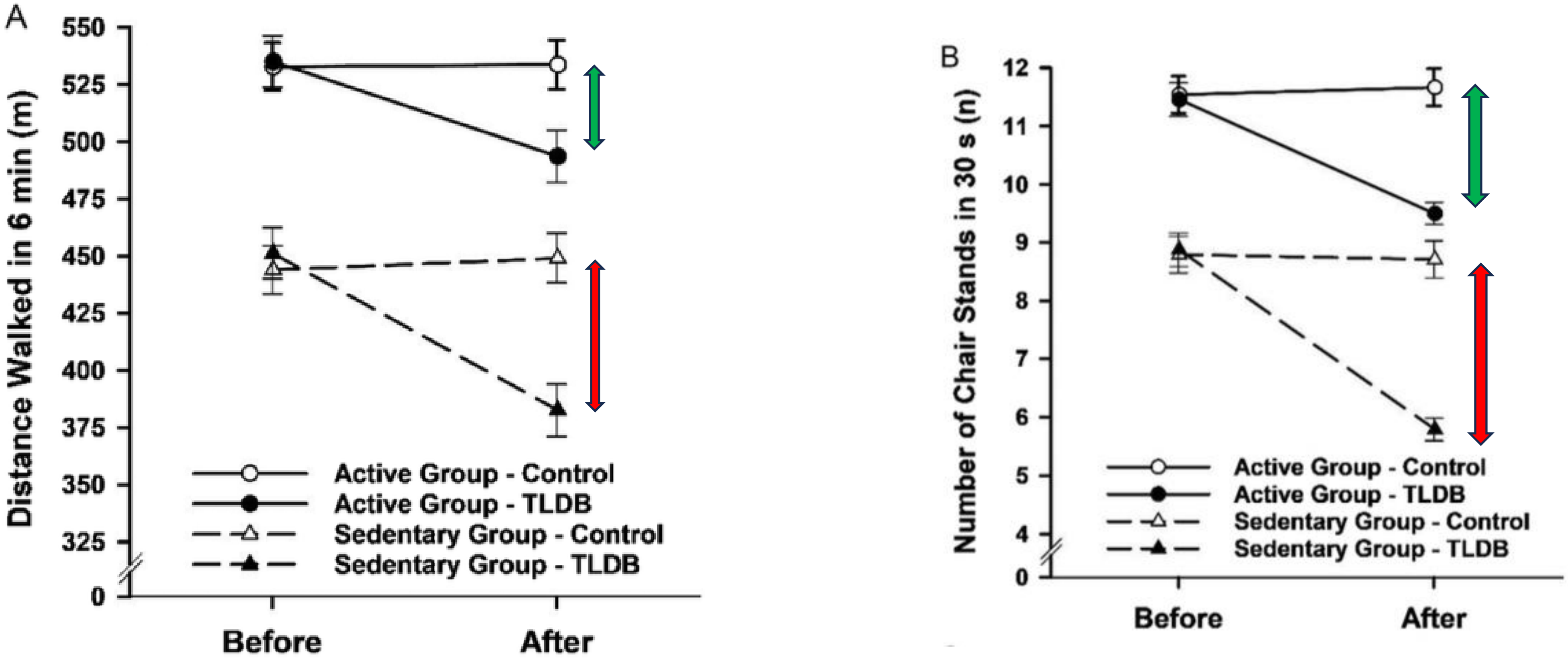
n = 48
71.0 ± 2.0 yrs

- Groupe 1 : active participants (n = 24)
  (Resistance exercises or walking at least 2x/ week)

- Groupe 2 : sedentary participants (n = 24)

Physical PRE test	Control versus Mental fatigue (Time Load Dual Back)	Physical POST test
6 min walking test (6MWT) Chair stands in 30 s (CS30)	20 min	6 MWT CS30

The role of physical activity



López-Rodriguez et al. (2025)

Habitual physical activity attenuated the effects of mental fatigue in older adults

Take home message

- Studies on mental fatigue in older adults are limited (n = 29) with highly variable protocols
- All studies reported subjective effects of mental fatigue
- Behavior changes (e.g., RT, accuracy) following mental fatigue are heterogeneous and depend on the experimental protocol
- A dual task may exacerbate the effects of mental fatigue on muscular endurance
- Mental fatigue alters balance and walking biomechanics → Risks of fall ?
- Habitual physical activity attenuates the effects of mental fatigue in older adults

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Review

Mental fatigue in older adults: A narrative review of subjective, behavioral, neurophysiological, and physical changes

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THANK YOU

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