



UNIVERSITÀ DEGLI STUDI DI MILANO  
SCUOLA DI SCIENZE MOTORIE

# IN SEARCH ... OF THE LOST BREATH!

Multilateral and integrated approach for Prevention, Treatment and Wellness

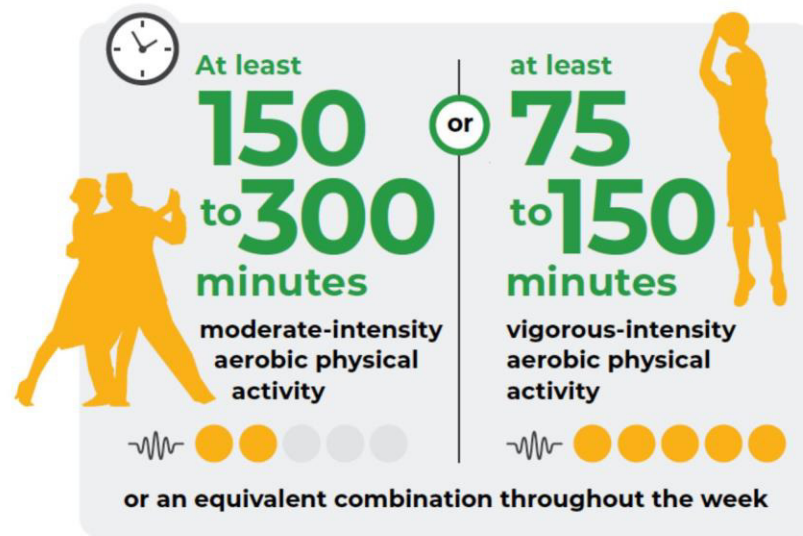
## The role of physical activity for our well-being

Fabio Esposito, MD – [Fabio.Esposito@unimi.it](mailto:Fabio.Esposito@unimi.it)



ADULTS

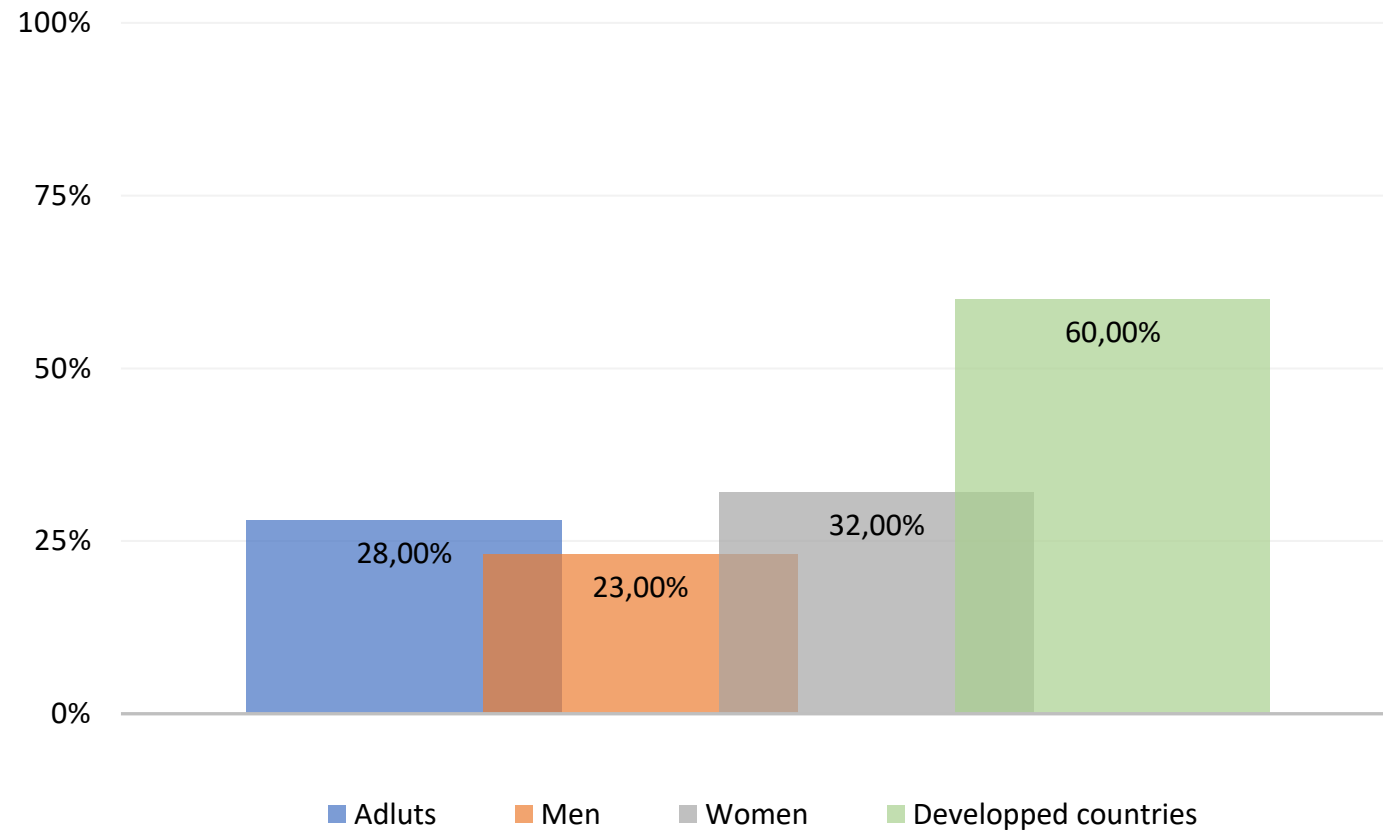
WHO guidelines on physical activity and sedentary behaviour



Active lifestyle

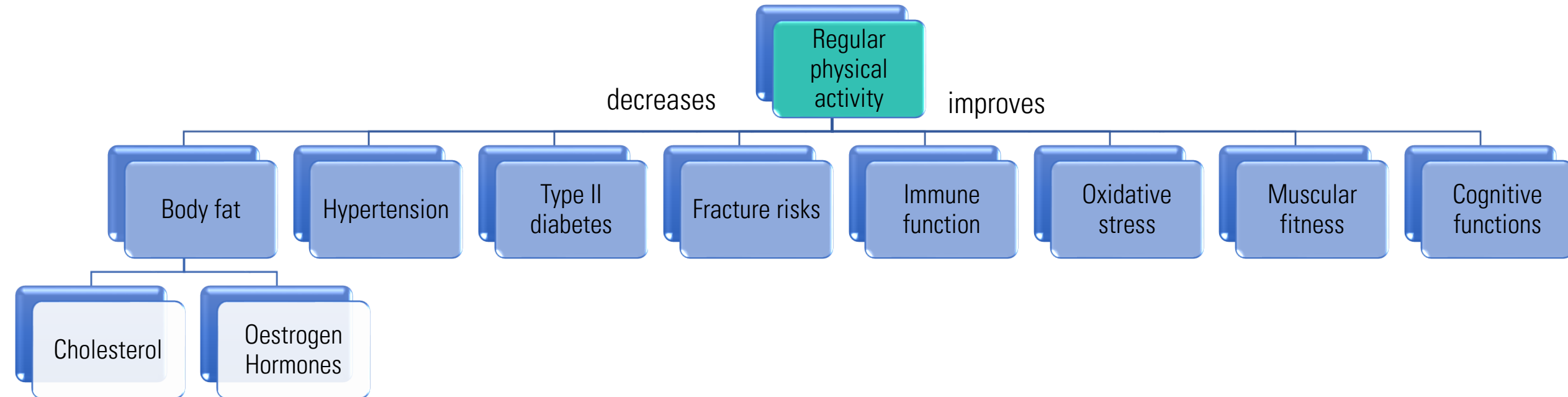
WHO, 2022

## Sedentary lifestyle in the world

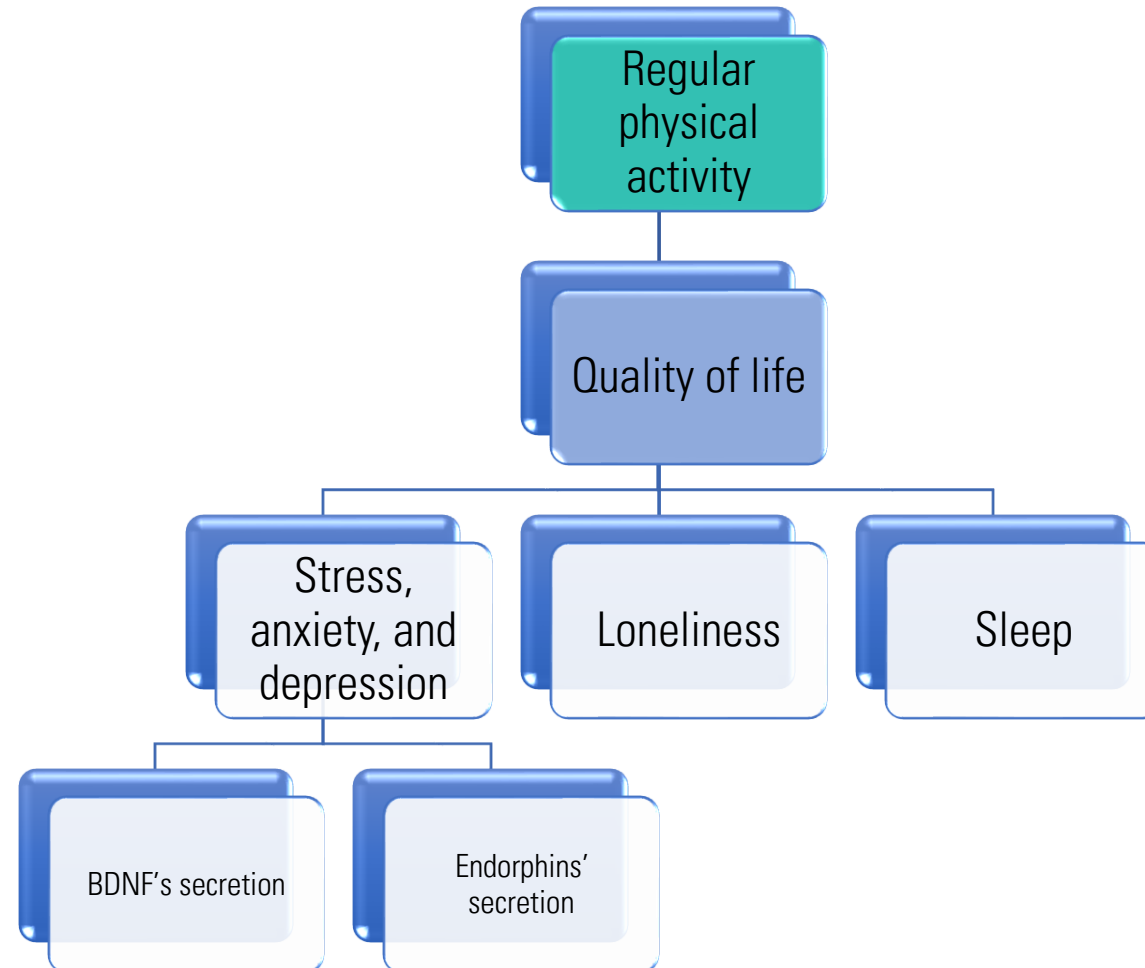


EpiCentro, Istituto Superiore di Sanità, 2022





Malm et al., 2019;



Malm et al., 2019;

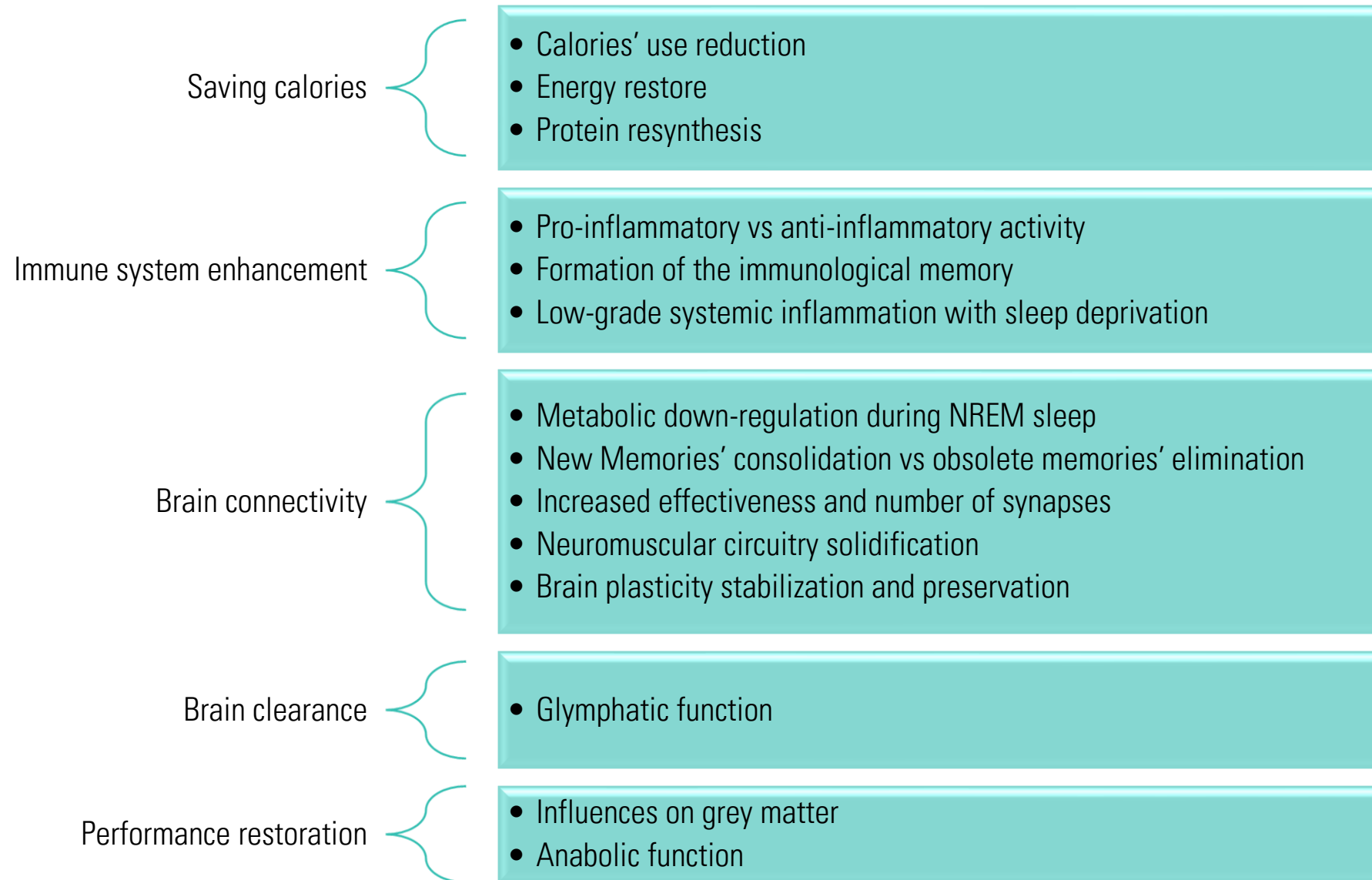


"A normal active state of all living creatures in which the mind and body are less responsive.

Sleep is a naturally recurring state of mind that is characterised by altered consciousness, the inhibition of almost all voluntary muscles, generally inhibited sensory activity, and a marked reduction in our interactions with our surroundings".

Carskadon & Dement, 1982

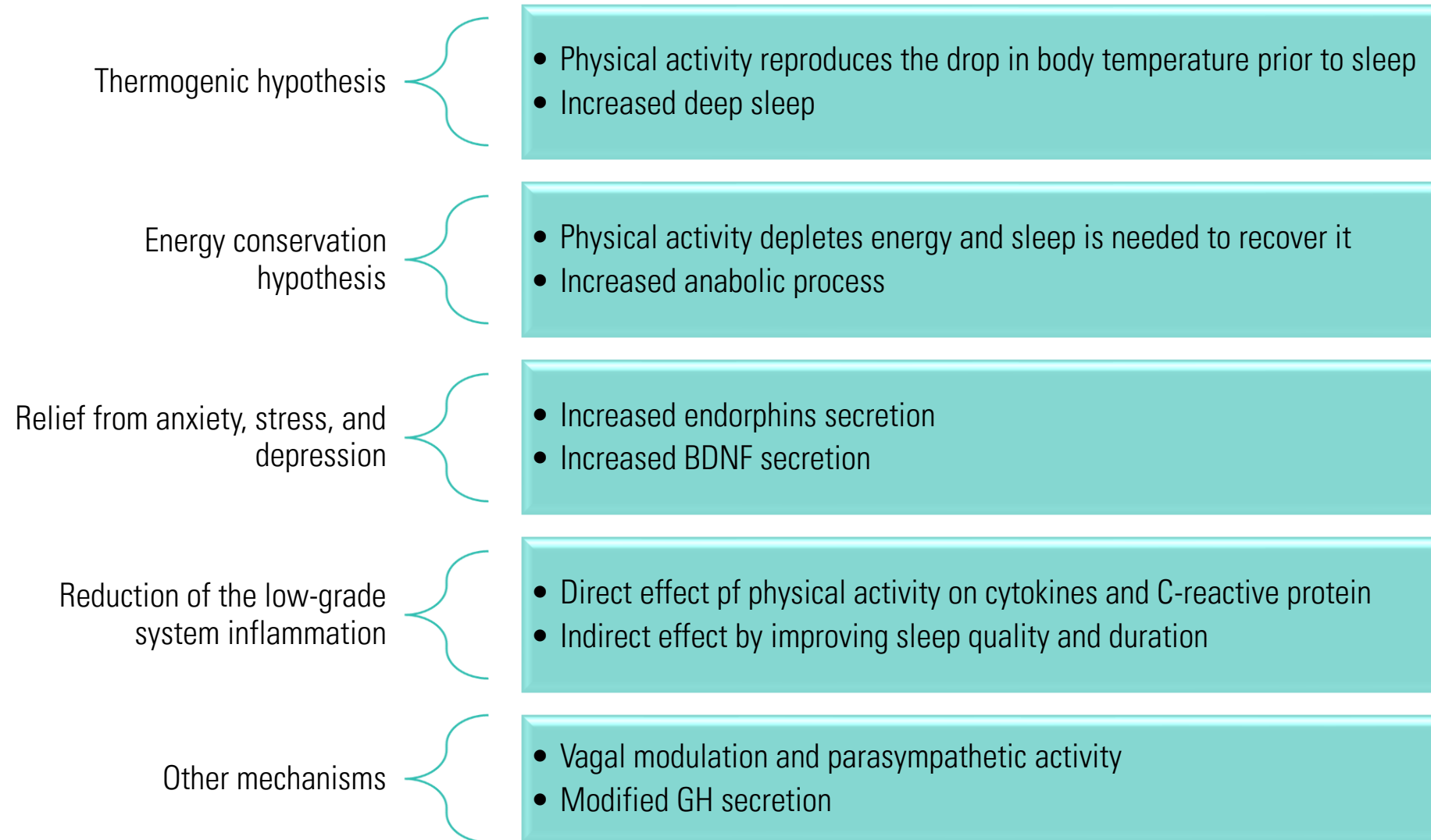




Krueger et al., 2016



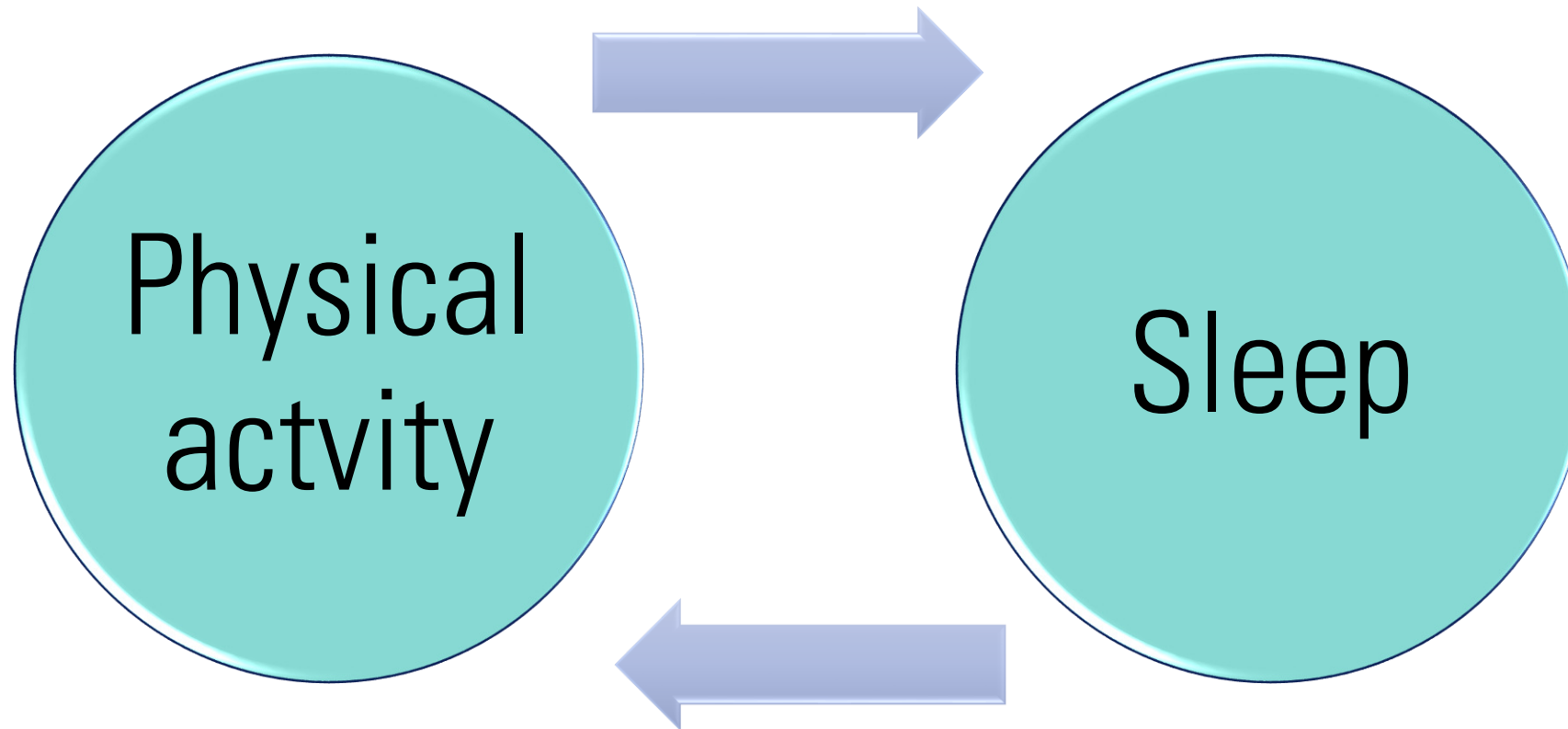
# Effects of physical activity on sleep

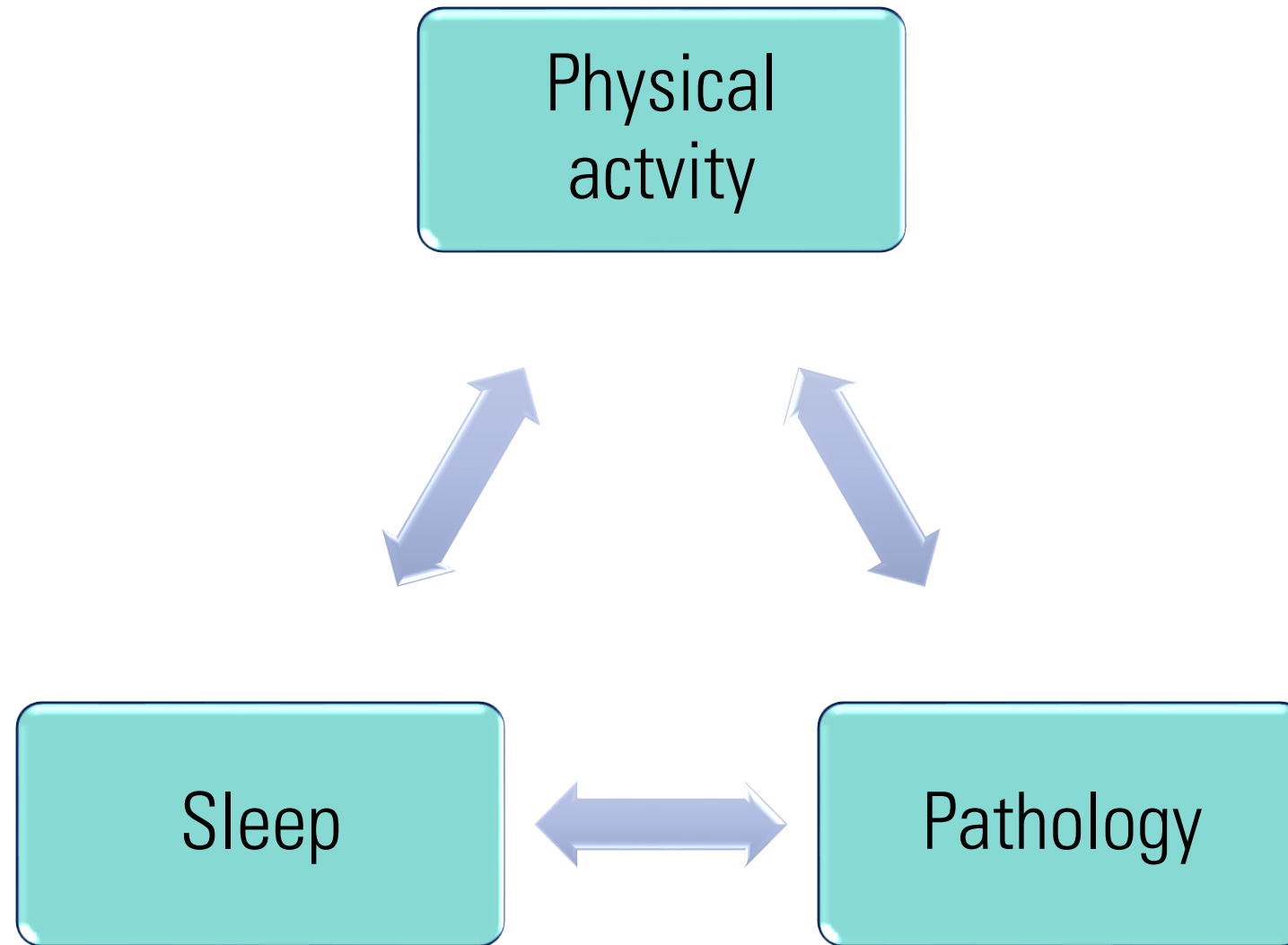


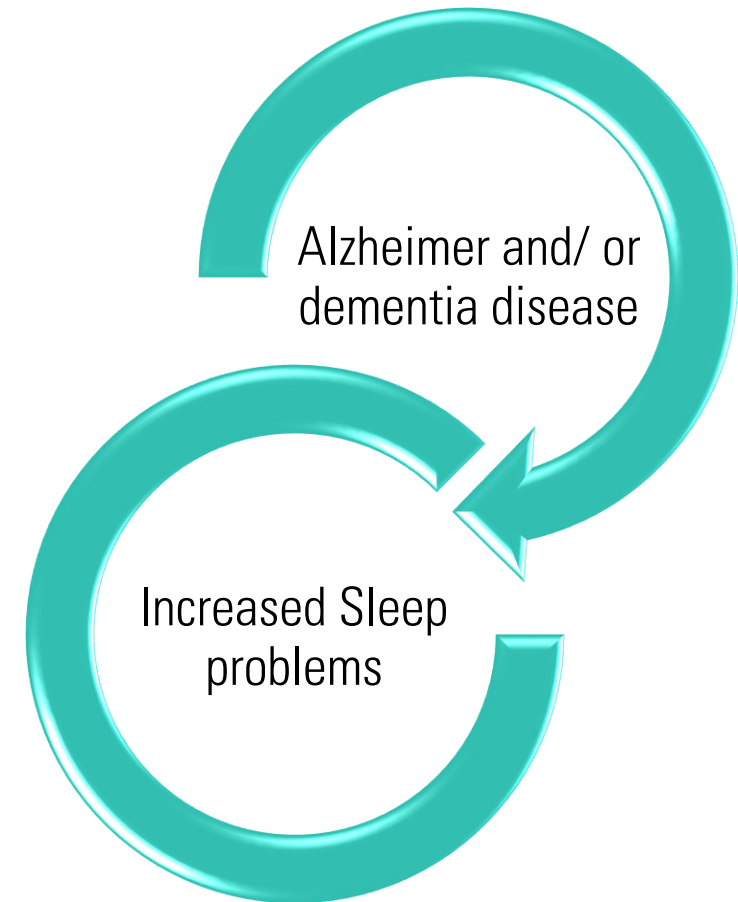
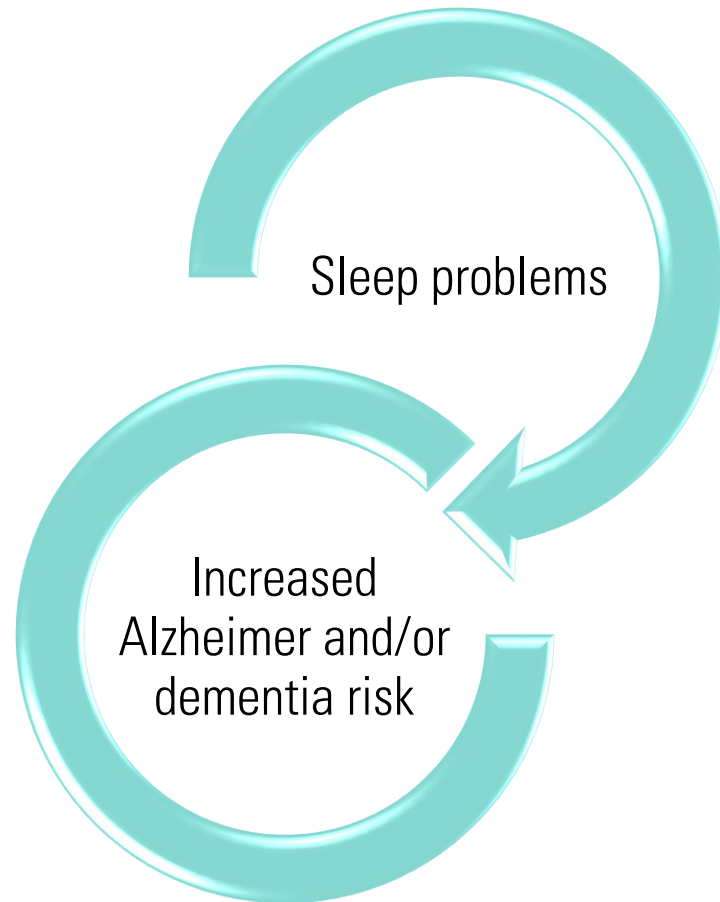
Chennaoui et al., 2014  
Driver and Taylor, 2000  
Farnsworth et al., 2015  
Irwin et al., 2016  
Leproult et al., 2009  
Monteiro et al., 2017  
Nam et al., 2016  
Shearer et al., 2001  
Uchida et al., 2012  
Zielinski et al., 2014

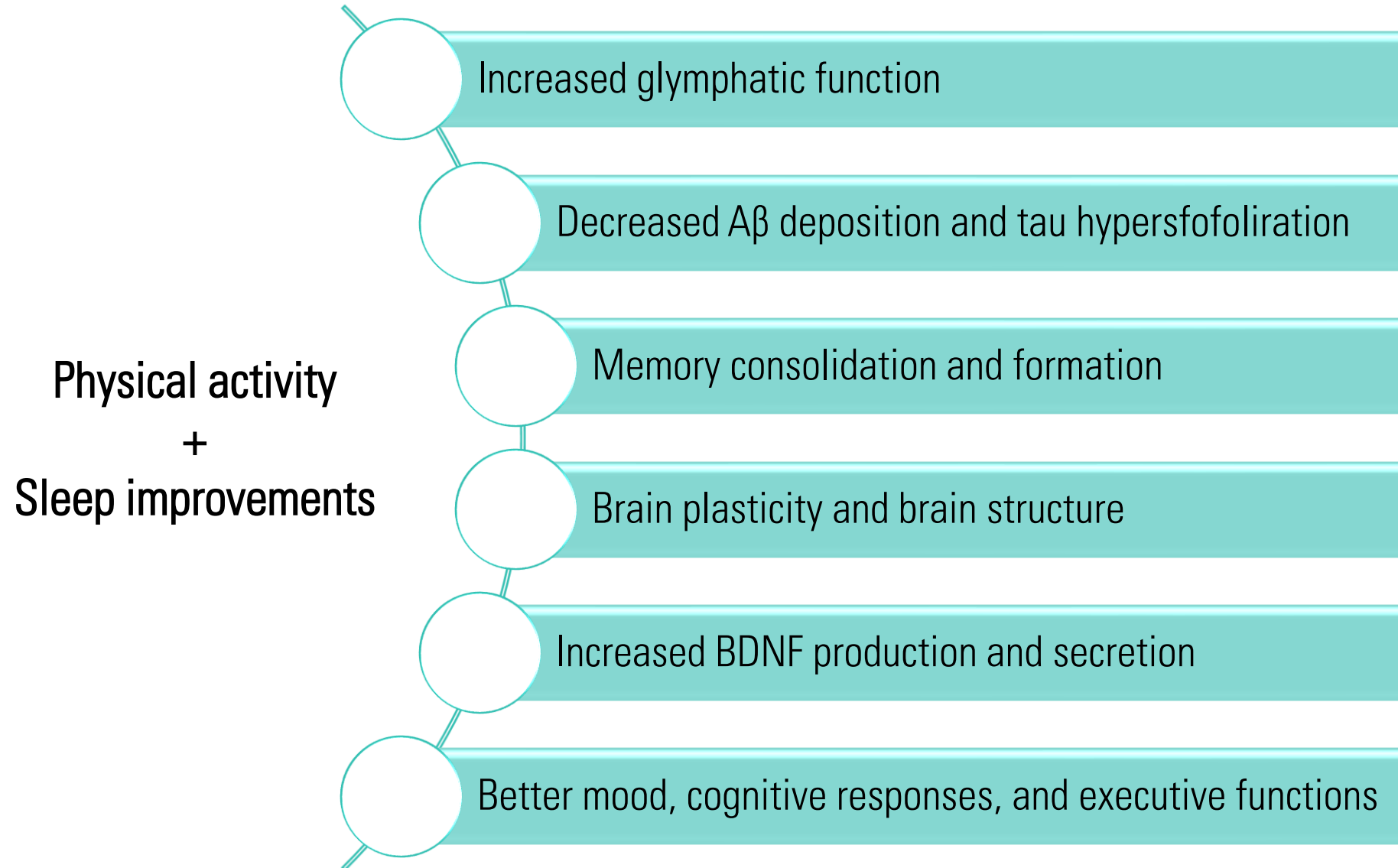












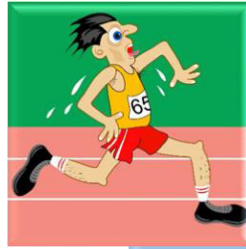
Dominguez et al., 2021  
Eshkoor et al., 2013  
Gholamnezhad et al., 2020  
Sewel et al., 2023





Review by Yang et al., 2022

- Improved sleep quality
- Reduced mortality risk



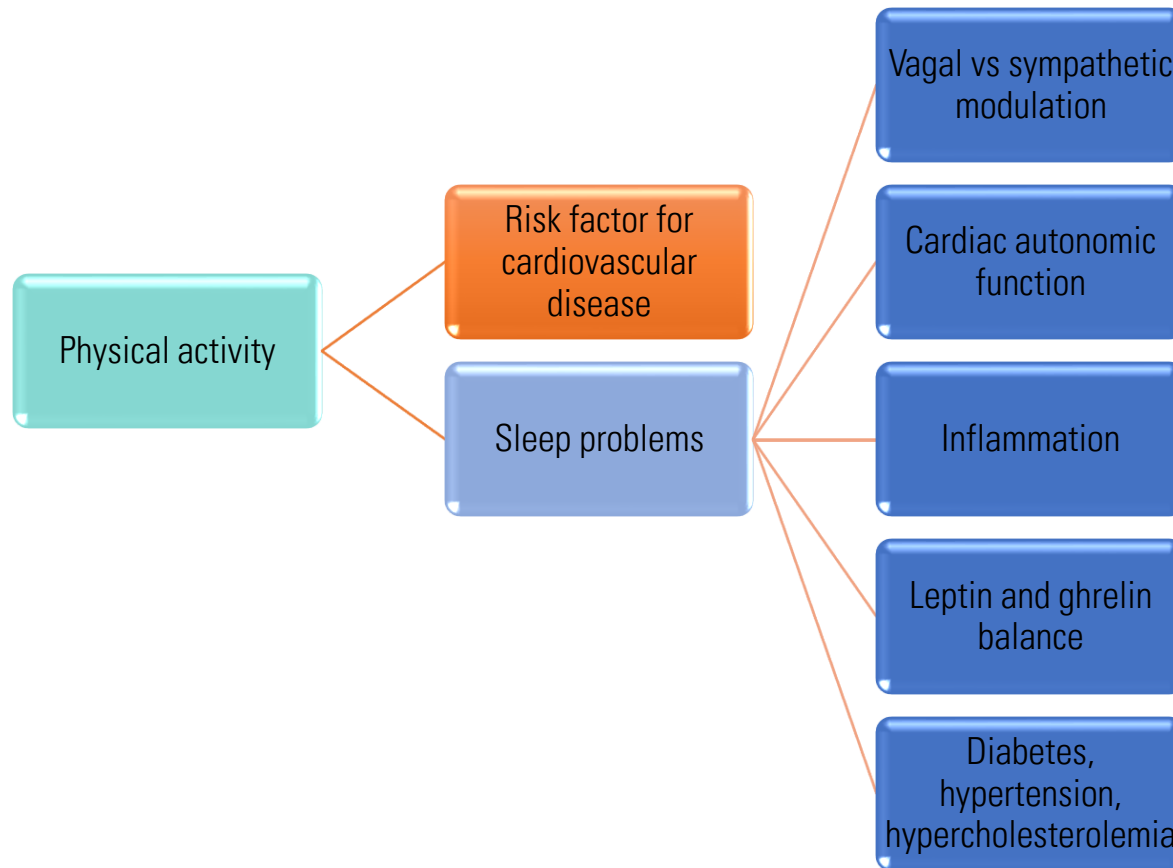
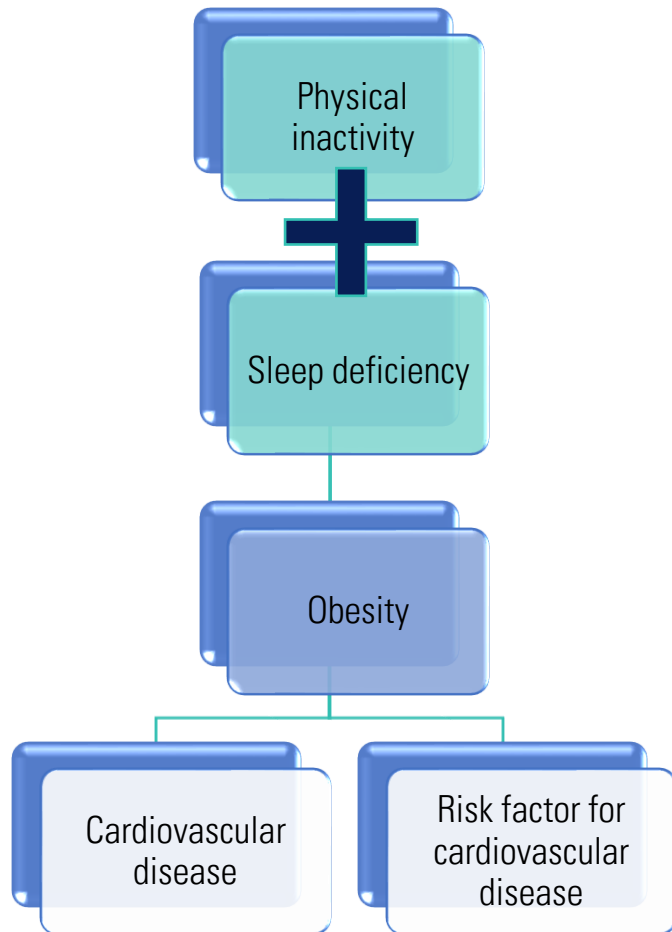
Review by Cristini et al., 2021

- Improved subjective sleep quality
- Increased N3 sleep stage
- Modifications in sleep architecture

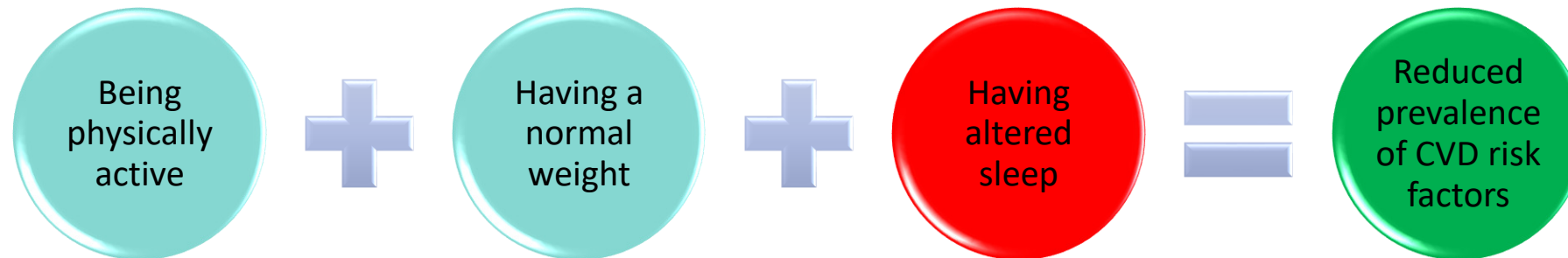
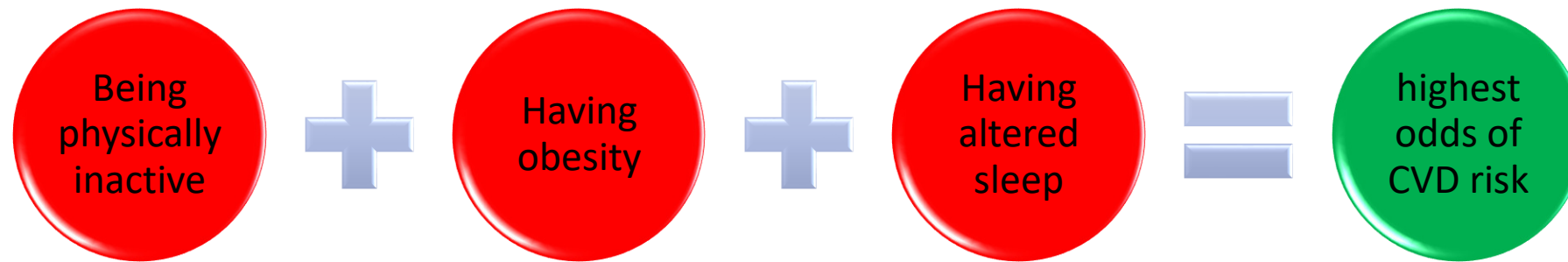


Review by Cristini et al., 2021

- Largest effects on subjective sleep quality
- Effects on both motor and non-motor symptoms.



Barroso et al., 2019  
de JS Soares-Junior et al., 2019  
Silva Soares Junior1 et al., 2022  
Valenzuela et al., 2022



Similar results to people having NORMAL sleep quality

Exercise may act as a mitigating factor for the damage caused by poor sleep quality.

de JS Soares-Junior et al., 2022  
Valenzuela et al., 2022



Studies involving breast cancer patients and survivors report that

Women more active during the day  
Women practicing more physical activity



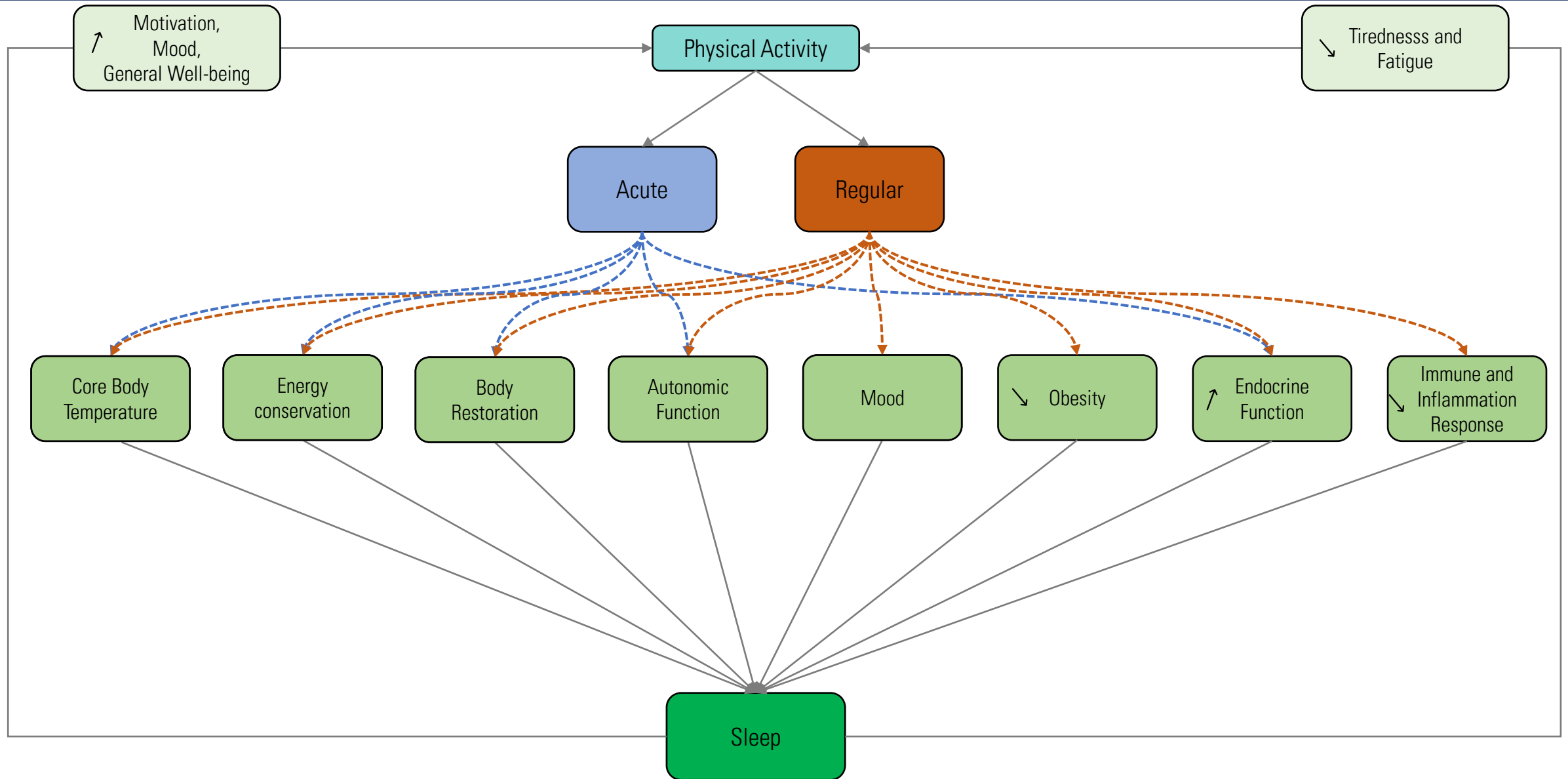
Women with fewer sleep problems  
Better sleepers

Courneya et al., 2014  
Fang et al., 2019  
Kreutz et al., 2019  
Rogers et al., 2017  
Tang et al., 2019  
Yang et al., 2021  
Yao et al., 2021





# Physical activity and sleep in pathological conditions: breast cancer



**The health of the future patient will partly depend on how incisive we are in prevention by using tools that converge in promoting an active lifestyle.**

**A physically active subject will undoubtedly be a healthier patient.**

**The patient of the future will reflect what his/her lifestyle will have been.**



# Respiratory muscle training

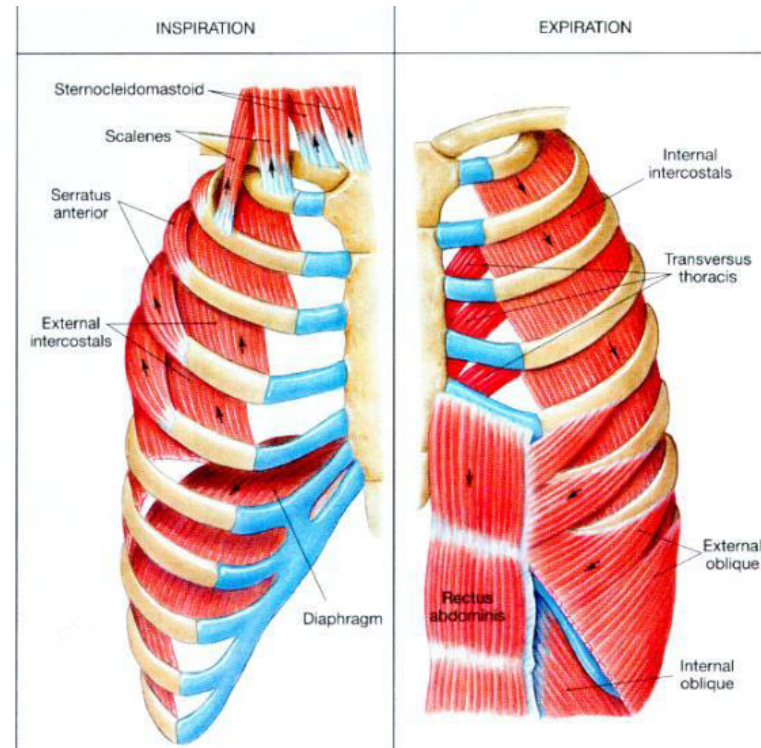
## INSPIRATORI

### PRINCIPALI

Diaframma  
Intercostali esterni

### ACCESSORI

Sternocleidomastoideo  
Scaleni  
Pettorale minore



## ESPIRATORI

### RESPIRAZIONE TRANQUILLA

Passivo ritorno dei polmoni e  
della gabbia toracica

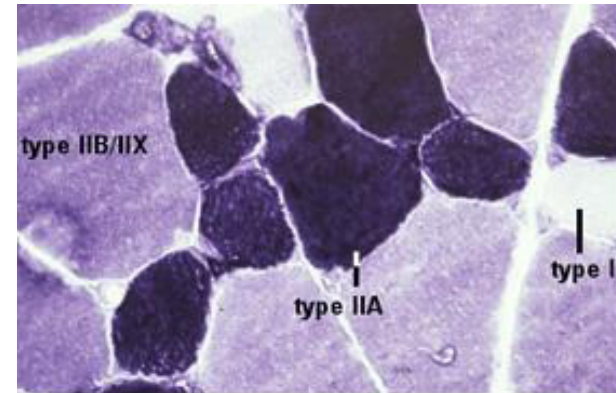
### RESPIRAZIONE ATTIVA

Intercostali interni  
Addominali

# BACKGROUND

## Proporzione delle fibre ossidative (tipo I e tipo IIA):

- Diaframma 80%
- Intercostali esterni 80%
- Intercostali interni 100%
- Muscoli degli arti 35-45%



Gollnick et al., JAP 1972

# BACKGROUND

## APPLICAZIONE DELL' ALLENAMENTO DEI MUSCOLI RESPIRATORI (RMT):

### MIGLIORAMENTO PERFORMANCE SPORTIVA

**Calcio** Archiza et al., J. Sports Sci. 2018

**Nuoto** Kilding et al., EJAP 2010

**Basket** Goosey-Tolfrey et al., BJSM 2010

**Triathlon** Inbar et al., MSSE 2000

**Canottaggio** Volianitis et al., MSSE 2001

**Ciclismo** Romer et al., MSSE 2002

### TRATTAMENTO PATOLOGIE SISTEMA RESPIRATORIO

#### **Broncopneumopatia cronica ostruttiva**

Bernardi et al., International Journal of COPD 2015

#### **Malattie neuromuscolari**

Gozal and Thiriet, MSSE 1999

#### **Malattie neurodegenerative**

Pinto et al., Amyotroph Lateral Scler. 2012

#### **COVID-19**

McNarry et al., Eur Respir J. 2022

# BACKGROUND

## TIPOLOGIE DI ALLENAMENTI MUSCOLI RESPIRATORI (RMT):

Inspiratory muscle training (IMT)



Expiratory muscle training (EMT)



Isocapnic hyperpnea training (IHT)



# BACKGROUND

## TIPOLOGIE DI ALLENAMENTI MUSCOLI RESPIRATORI (RMT):

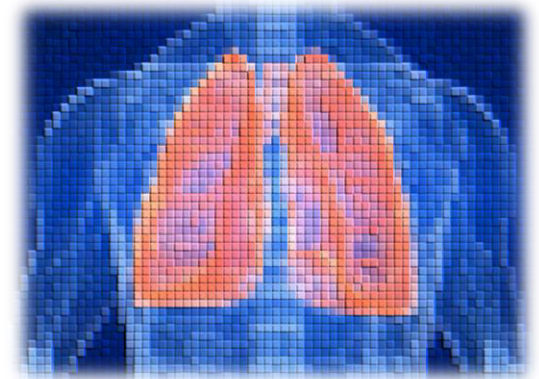
Device	Adequate load range	Portability	Usability	Adequate mouthpiece sealing	Possibility of home-based training	Easy/fast adjustment	Allows inspiratory and expiratory training	Cost effectiveness (inexpensive)
Resistance-training devices								
Pflex®	No	Yes	Yes	No	Yes	Yes	No	Yes
TrainAir®	Yes	No	No	Yes	No	No	No	No
POWERbreathe® K-Series	Yes	Yes	Yes	Yes	Yes	Yes	No	No
EMST 150	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Orygen-Dual Valve®	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
POWERbreathe®	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
PowerLung ®	*	Yes	Yes	Yes	Yes	Yes	Yes	No
Respifit-S	Yes	Yes	No	Yes	No	Yes	No	No
Threshold® IMT	No	Yes	Yes	No	Yes	Yes	No	Yes
Threshold™ PEP	No	Yes	Yes	No	Yes	Yes	No	Yes
Endurance-training device								
SpiroTiger®	Yes	Yes	No	Yes	No	No	Yes	No
* Not reported								

**Table 1:** Characteristics of the evaluated respiratory muscle training devices.

# BACKGROUND

Principali parametri dell'allenamento dei muscoli respiratori:

- durata;
- numero di ripetizioni;
- numero di serie;
- % di intensità di pressione (MIP-MEP);
- % della capacità vitale (VC)
- % della massima ventilazione volontaria (MVV)







# Protocollo allenamento: Isocapnic Hyperpnea Training (IHT)

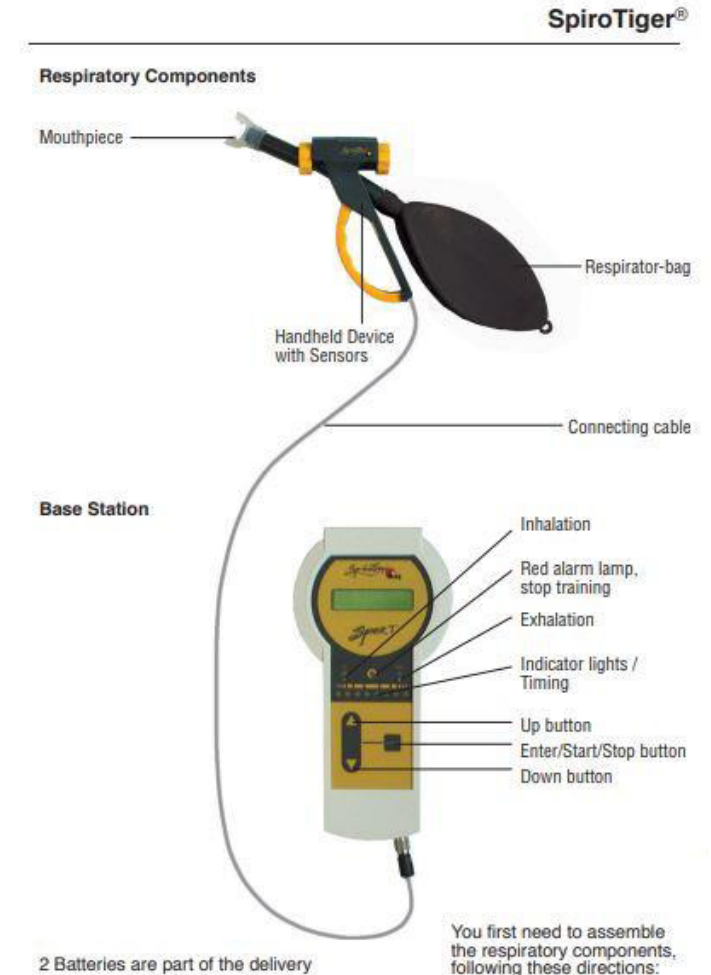
Valvola a pistone a due vie collegata a una sacca di respirazione

La sacca per la respirazione immagazzina parte dell'aria espirata con una maggiore concentrazione di CO<sub>2</sub>

Nonostante l'elevata frequenza respiratoria, l'ipocapnia viene evitata

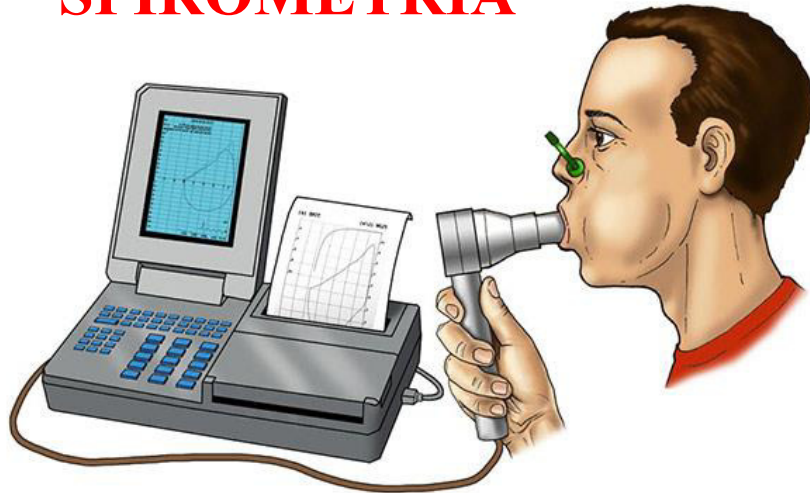
## Parametri allenamento

1. Volume sacca: 50-60% VC
2. Frequenza respiratoria: 50-60% MVV
3. Durata sessione: 24'



# VALUTAZIONI:

## SPIROMETRIA



- Capacità Vitale (CV)
- Capacità vitale forzata (CVF)
- Volume espiratorio forzato ( $FEV_1$ )
- Massima ventilazione volontaria (MVV)

## PRESSIONI RESPIRATORIE

Massima pressione  
inspiratoria

**MIP**

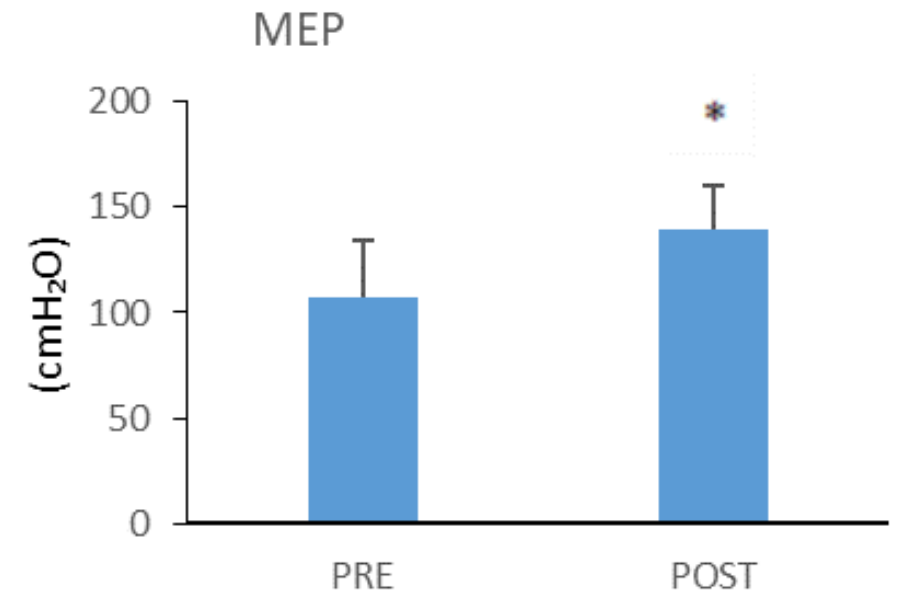
Massima pressione  
espiratoria

**MEP**



# RISULTATI

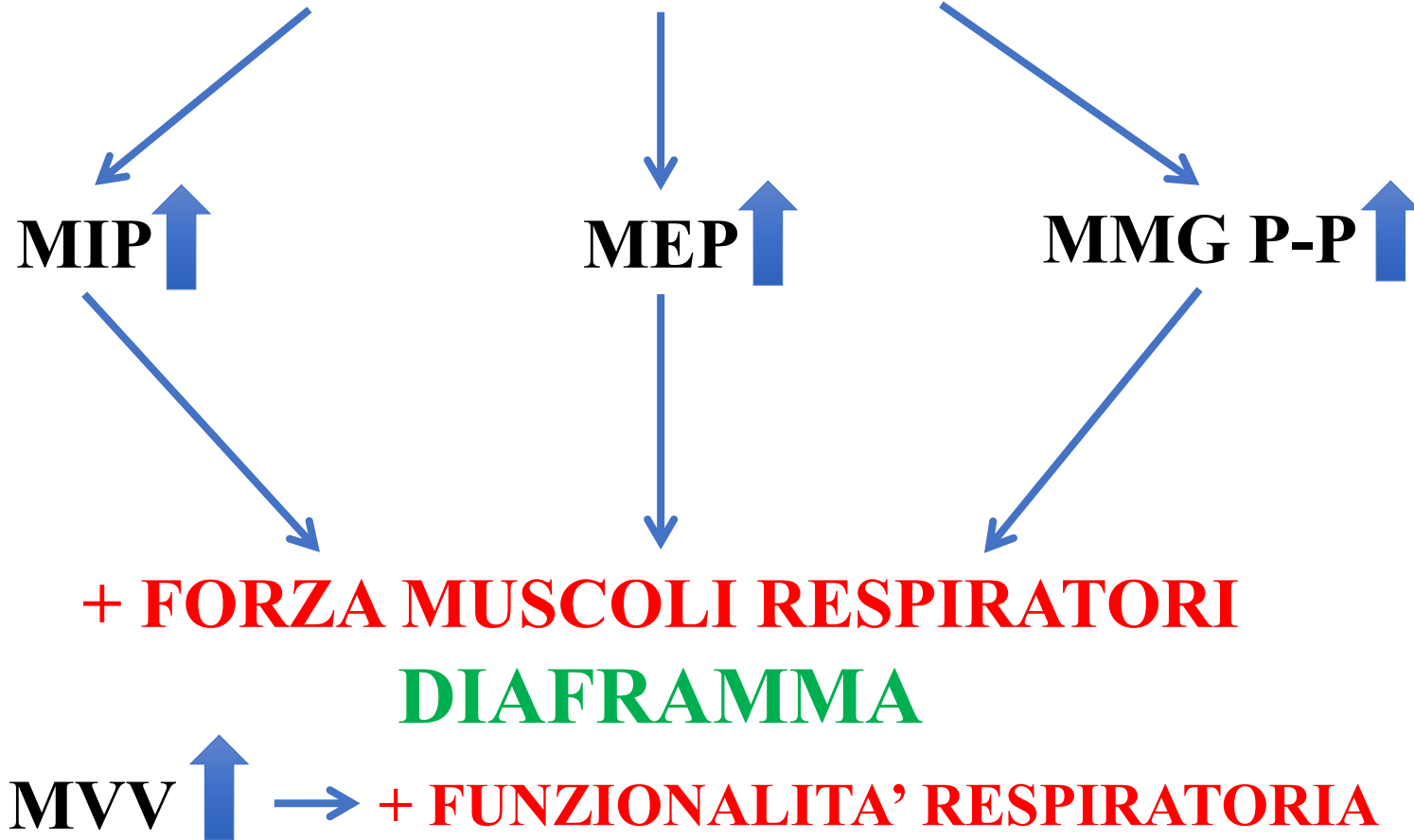
	PRE	POST	Variazione %
FVC (l)	4,61±1,20	4,57±1,04	0%
FVC (%)	102±12	102±10	
SVC (l)	4,25±0,82	4,46±0,97	5%
SVC (%)	93±8	98±11	
MVV (l/min)	166±46	181±39 *	11%
MVV (%)	118±18	130±14 *	
MIP (cmH <sub>2</sub> O)	110±46	127±35 *	26%
MIP (%)	114±31	141±14 *	
MEP (cmH <sub>2</sub> O)	108±27	139±21 *	34%
MEP (%)	95±22	125±22 *	



\* P < 0,05 vs PRE

# Conclusioni

ALLENAMENTO IN IPERPNEA ISOCAPNICA

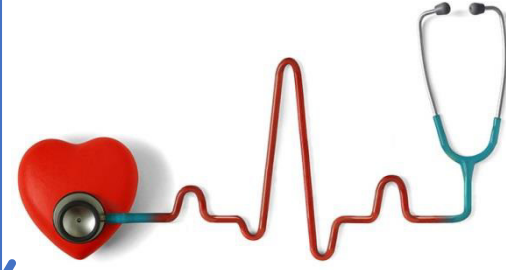


# Conclusioni

ALLENAMENTO IN IPERPNEA ISOCAPNICA



Sport



Campo medico

**BPCO**

**SLA**

- + Capacità respiratoria
- + Qualità di vita



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Thank you for your attention!