



BEWEGUNG ALS MEDIZIN

Langeskov-Christensen et al., 2024. Exercise as medicine in Parkinson's disease. Journal of Neurology, Neurosurgery and Psychiatry,

Jorina Janssens

MSc Physiotherapeutin

CAS Neurophysiotherapie Fachexpertin Morbus Parkinson

Dozentin BFH - Uni Basel

Mitgründerin & Mitglied Schweizer Parkinson Netzwerk Mittelland

Mitgründerin Parkinson Guide



Alle Abbildung aus Canva Design



INHALT

1

Ein Blick auf
die Krankheit

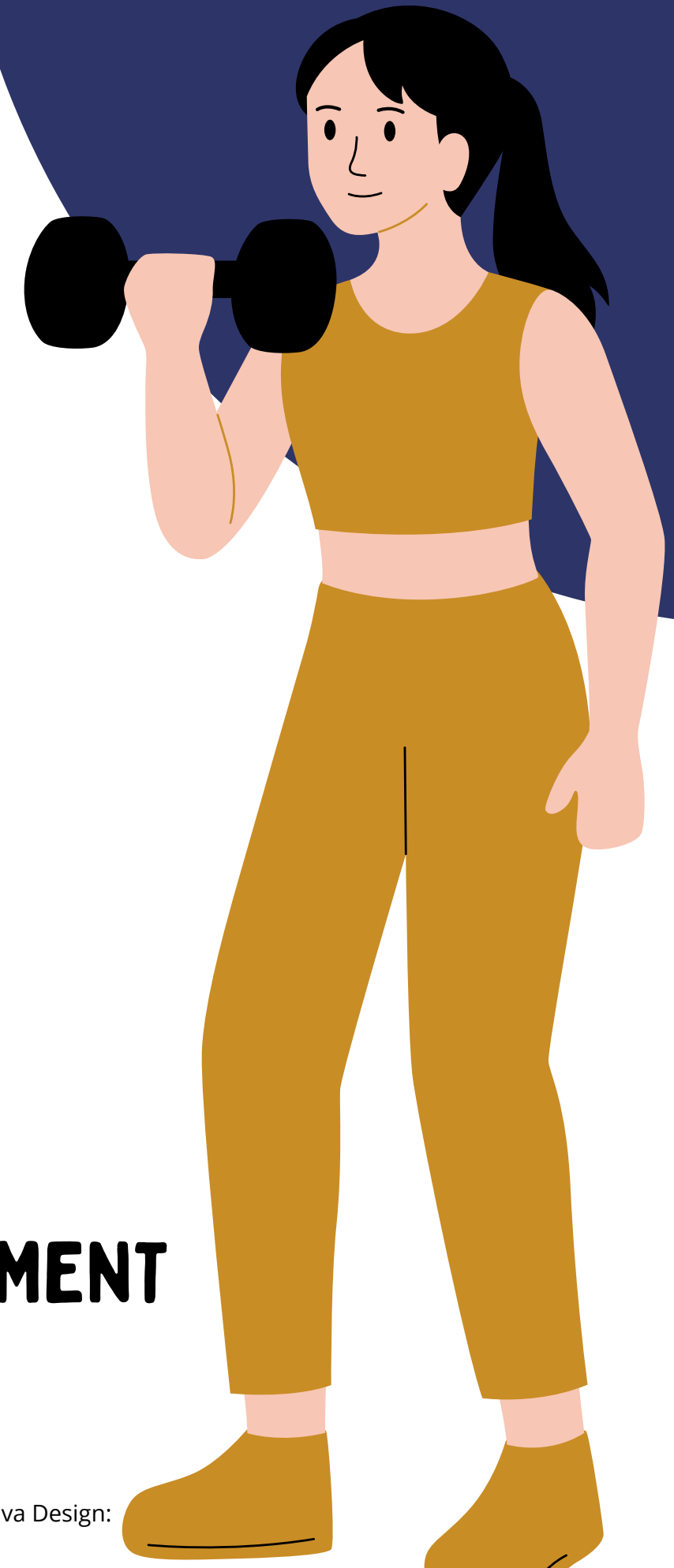
2

Warum
Bewegung
hilft?

3

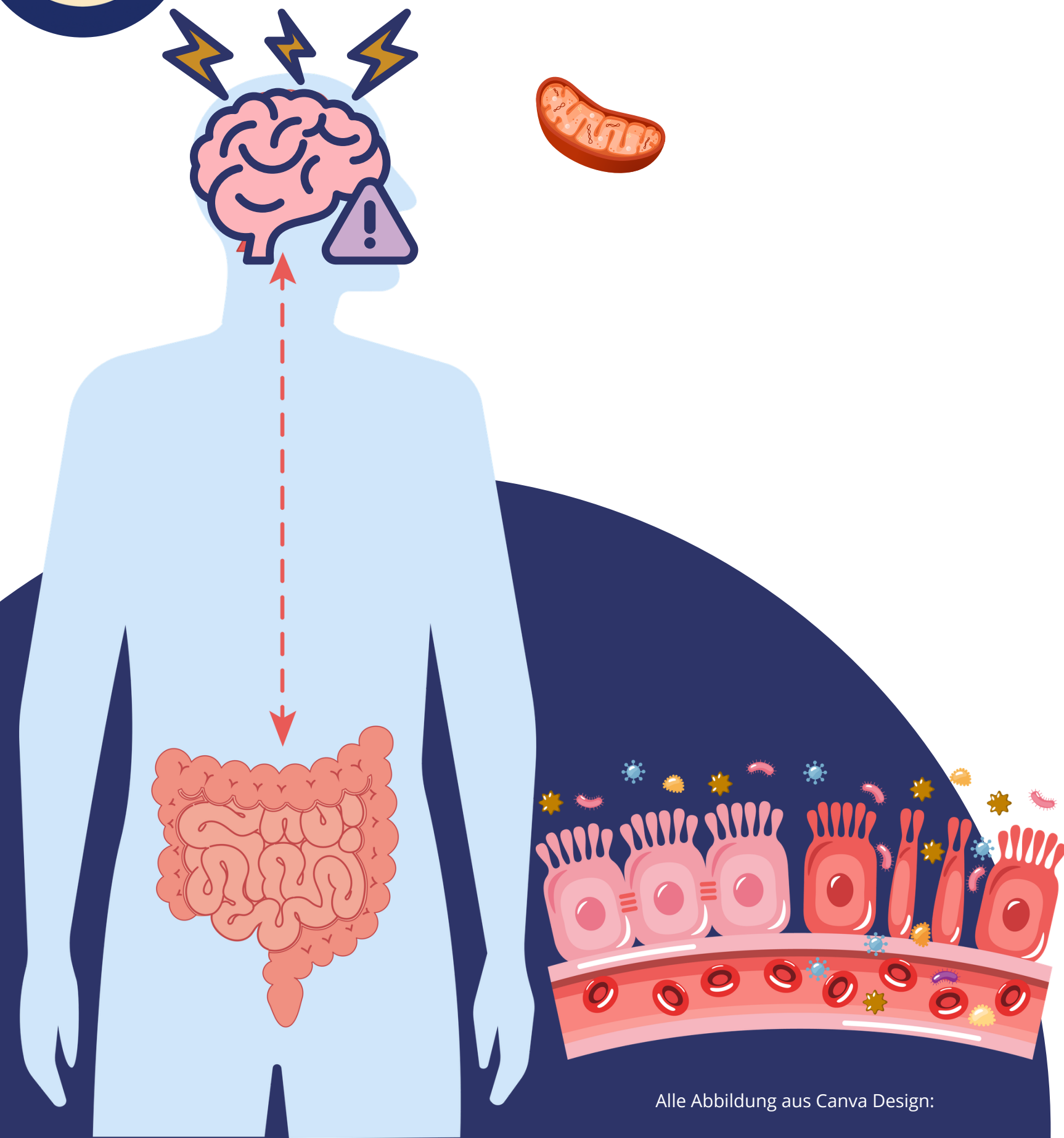
Bewegungs-
pyramide

MUT - HOFFNUNG - SPASS - LEBENSQUALITÄT - SELBSTMANAGEMENT





1 - PARKINSON



ABLAGERUNGEN

- Fehlfaltung Protein (alpha-Synucleine)
- Verbreitung

DARM-HIRN-ACHSE

- Veränderungen im Darm - durchlässig
- Neuroinflammation
- Chronische Entzündungsprozesse



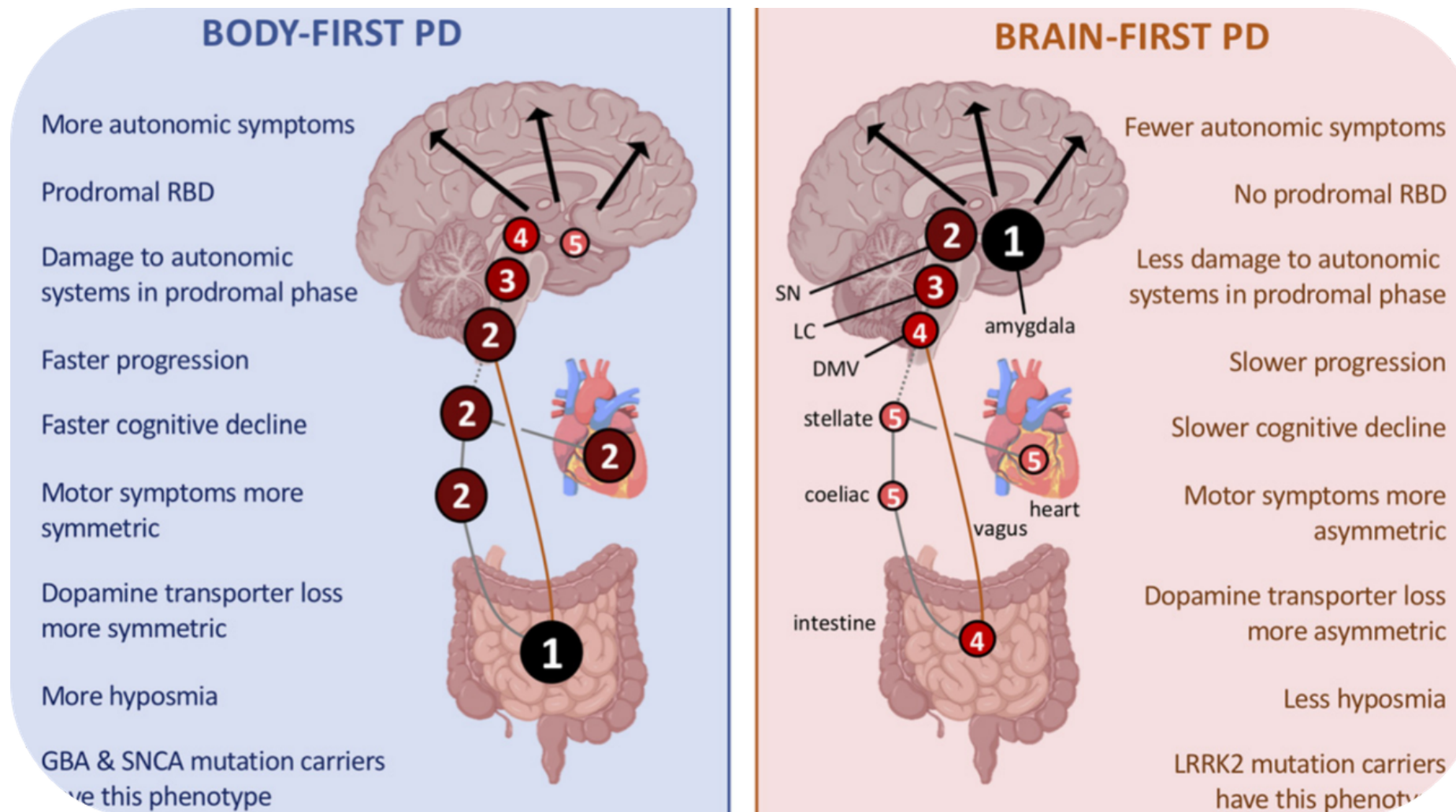
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Quelle: Borghammer P, Van Den Berge N. 2019 Brain-First versus Gut-First Parkinson's Disease: A Hypothesis. J Parkinsons Dis.



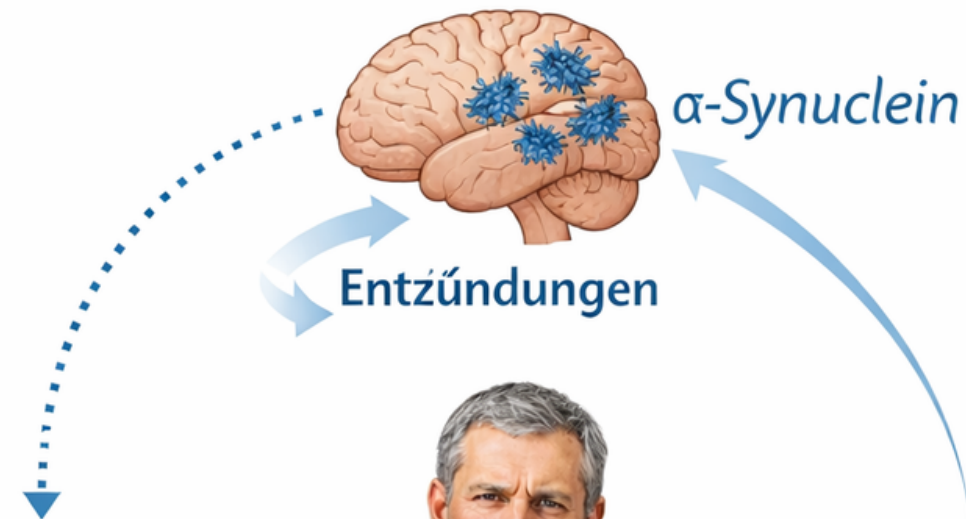
1 - PARKINSON

MOTORISCHE SYMPTOME

- Verlangsamung - Blockade
- Steifigkeit
- Tremor
- Gleichgewichtsunsicherheit

NICHT-MOTORISCH

- Fatigue, Depression, Apathie
- Schlafstörungen
- Obstipation
- Schmerzen
- Konzentrations- und Gedächtnisdefizite



Motorische Symptome

- Verlangsamung
- Tremor
- Steifigkeit
- Gleichgewichtsstörung



Nicht-motorische Symptome

- Fatigue
- Depression
- Obstipation
- Gedächtnisstörungen
- Schlafstörungen
- Riechstörungen



2 - BEWEGUNG

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BEWEGUNG

- Regelmässige, auch intensivere Aktivität wirkt dosisabhängig positiv;
- Physiotherapie



ERNÄHRUNG

- Mediterrane Kost,
- wenig verarbeitete Lebensmittel sowie Prä- und Probiotika zeigen vielversprechende Effekte
- Ernährungsberatung



LIFESTYLE MEDICINE

STRESSMANAGEMENT

- Insbesondere Achtsamkeit kann Progression reduzieren
- Ergotherapie / Psychotherapie



SCHLAF

- Wichtiger Baustein für Prävention und Therapie



SOZIALE INTERAKTIONEN

- soziale Einbindung stärkt Resilienz und Lebensqualität
- offene Kommunikation
- Freundschaften, Gruppe, Parkinson-Café





2 - BEWEGUNG LITERATUR

- Neuroprotektion
- Myokines - Exerkines
- Unterschiedliche Sportarten

PERSON

- Vorliebe - Abneigungen
- Regionale Angebote
- Situation - Hindernisse
- “Eigener” Parkinson

Quelle:

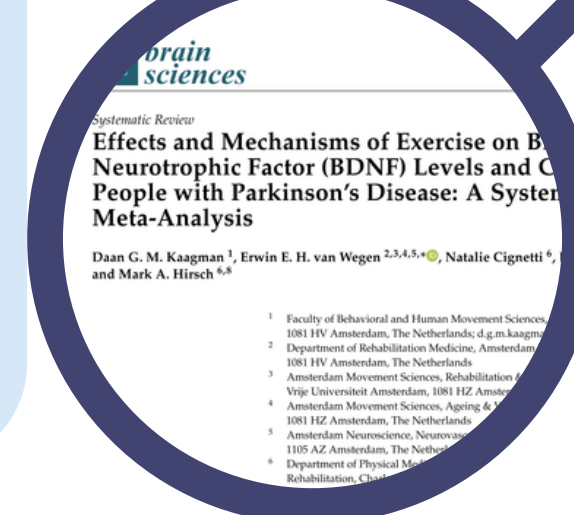
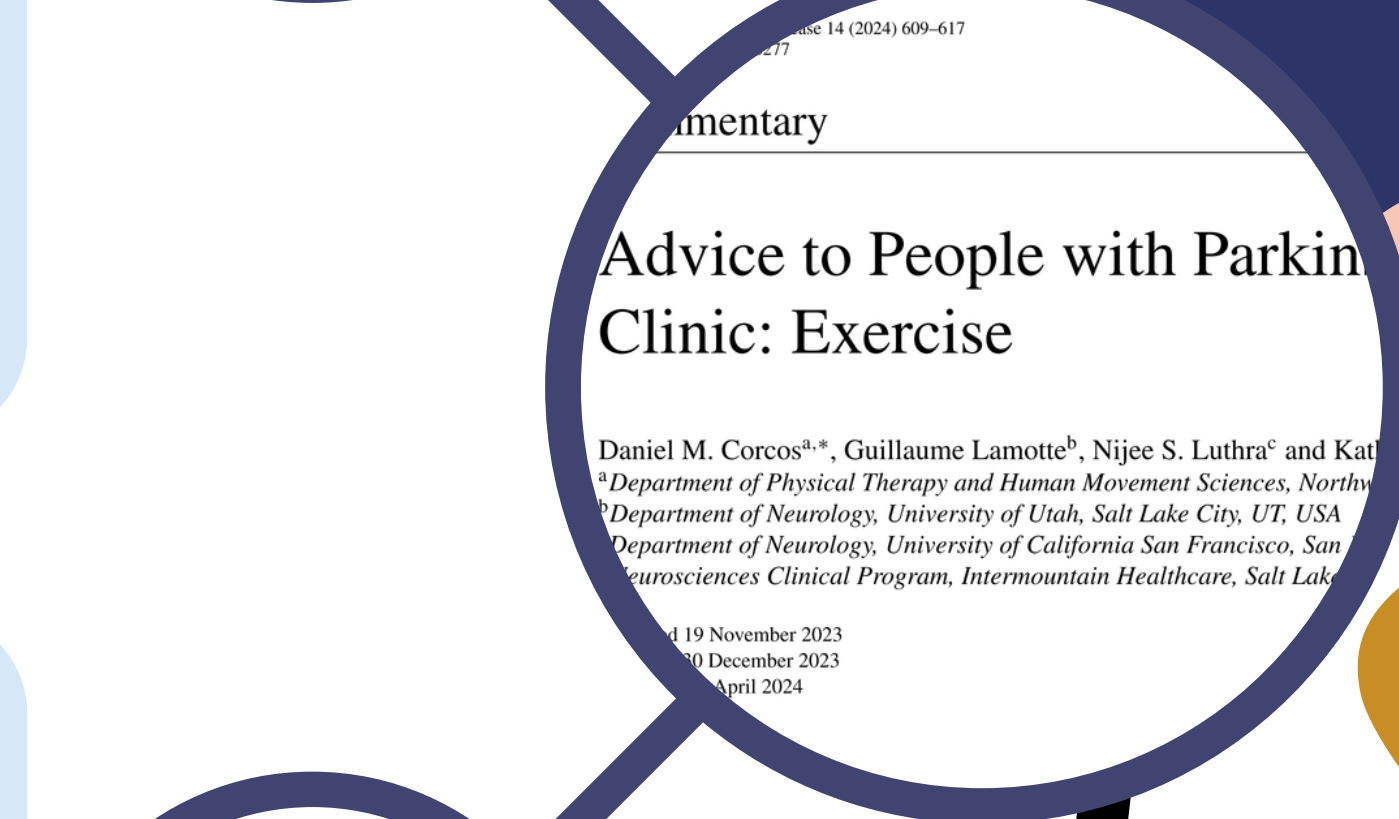
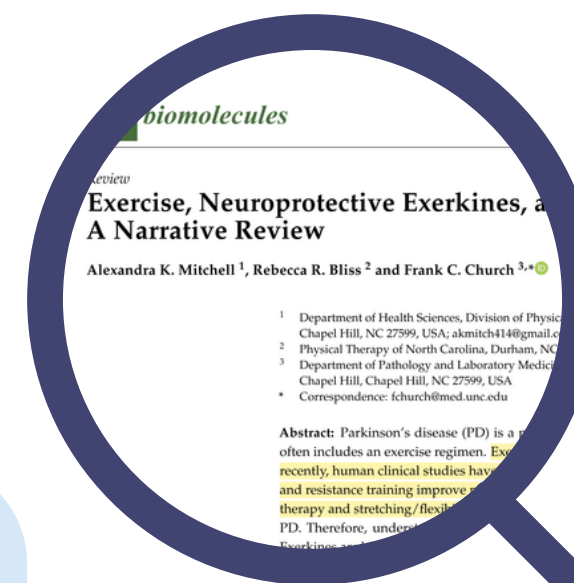
Burtscher et al., 2021 The muscle-brain axis and neurodegenerative diseases: the key role of mitochondria in exercise-induced neuroprotection

Mitchel et al., 2024 Exercise , Neuroprotective Exerkines , and Parkinson ’ s Disease: A Narrative Review

Phino et al., 2024 Physical exercise-mediated neuroprotective mechanisms in Parkinson’s disease, Alzheimer’s disease, and epilepsy

Corcos et al., 2024 Advice to People with Parkinson’s in My Clinic: Exercise. Journal of Parkinson's Disease

Kaagman et al., 2024. Effects and Mechanisms of Exercise on Brain-Derived Neurotrophic Factor (BDNF) Levels and Clinical Outcomes in People with Parkinson’s Disease: A Systematic Review and Meta-Analysis. Brain Sciences



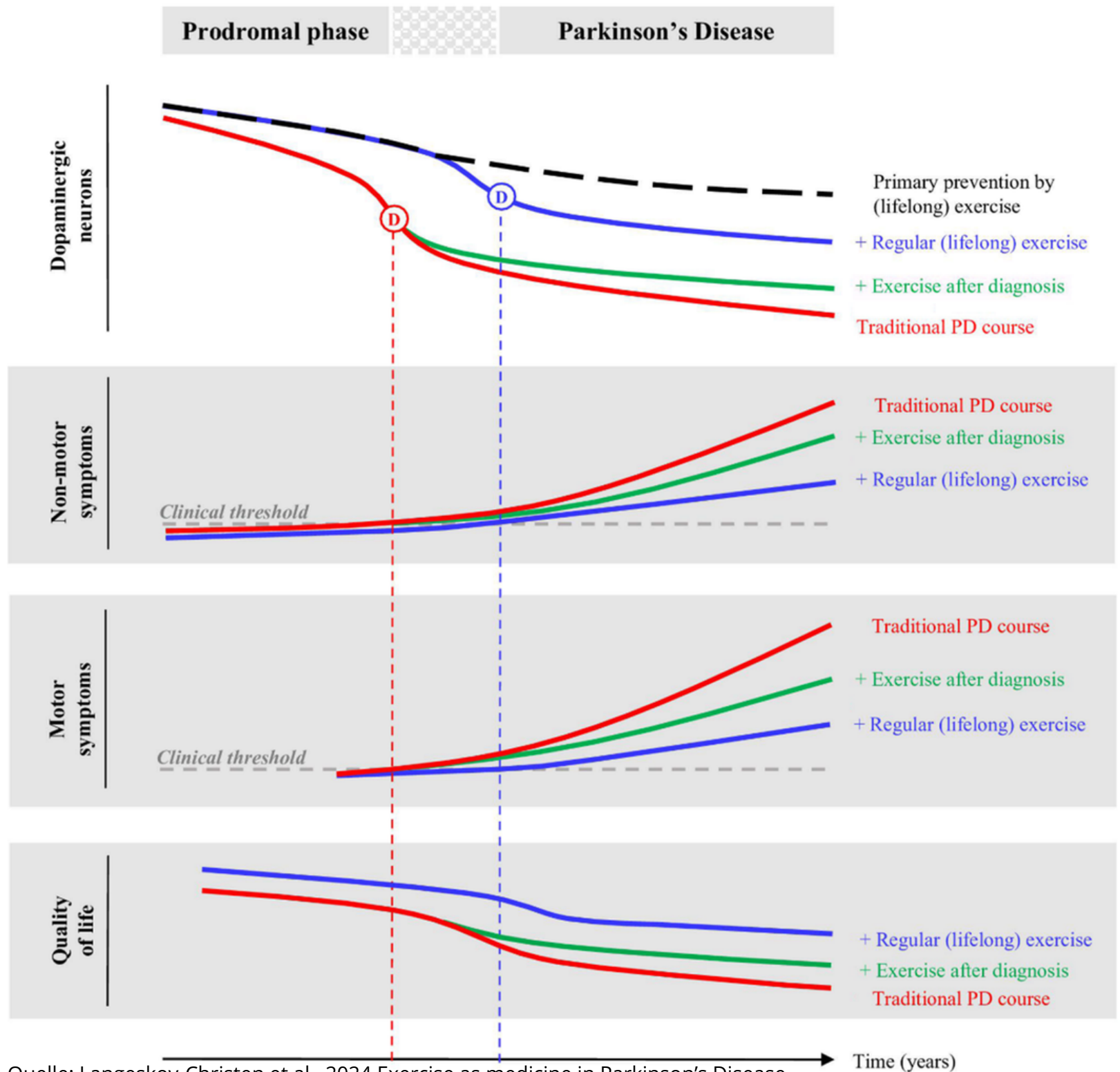
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Alle Abbildung aus Canva Design:





2 - BEWEGUNG



Quelle: Langeskov-Christen et al., 2024 Exercise as medicine in Parkinson's Disease

Quelle:

Langeskov-Christen et al., 2024 Exercise as medicine in Parkinson's Disease

Sanaeifar et al., 2024 Beneficial effects of physical exercise on cognitive-behavioral impairments and brain-derived neurotrophic factor alteration in the limbic system induced by neurodegeneration

Ishaq et al., 2024 Effects of exercise training on nigrostriatal neuroprotection in Parkinson's disease: a systematic review & de Laat et al., 2024 Intense exercise increases dopamine transporter and neuromelanin concentrations in the substantia nigra in Parkinson's disease

Chen et al., 2020 Effect of Exercise on Quality of Life in Parkinson's Disease: A Systematic Review and Meta-Analysis

Effekte: viel mehr als 'gute Kondition' und bessere Motorik

Nicht-motorische Symptome: Bewegung lindert Depression, Angst, Schlafstörungen und Fatigue und verbessert kognitive Funktionen.

Lebensqualität: Regelmässiges Training steigert Wohlbefinden, Energie und Alltagsfunktion.

Medikation: Sport kann die dopaminerge Signalübertragung verbessern und den Bedarf an Medikamenten senken.



Alle Abbildung aus Canva Design: kostenloses Angebot



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Freisetzung Exerkines -
Myokines

Unterschiedliche Wirkung

Plastizität, Angiogenese

Alle Abbildung aus Canva Design:



Quelle:

Burtscher et al., 2021 The muscle-brain axis and neurodegenerative diseases: the key role of mitochondria in exercise-induced neuroprotection

Mitchel et al., 2024 Exercise , Neuroprotective Exerkines , and Parkinson ' s Disease: A Narrative Review

Phino et al., 2024 Physical exercise-mediated neuroprotective mechanisms in Parkinson's disease, Alzheimer's disease, and epilepsy: Cyrus Safaeipour, BS et al., 2026 Exercise and Brain Health:Expert Review Lifestyle Medicine and Preventive Neurology

Naser AA,et al., 2025 The Effect of Multimodal Exercise on the Levels of BDNF and GDNF in Patients with Parkinson's Disease.

Xu G, et al., 2025. Intervention strategies for Parkinson's disease: the role of exercise and mitochondria. Front. Aging Neurosci.

Yang S,et al. 2026 Therapeutic potential of exerkines in neurodegenerative and mental disorders: a narrative review. Front. Physiol.

Li et al.,2025 Exercise as a multitarget therapy: modulating myokines, neurotrophins, and inflammation in Parkinson's disease. Front. Aging Neurosci.

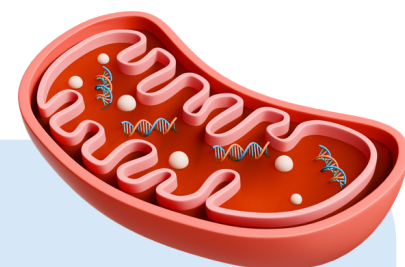


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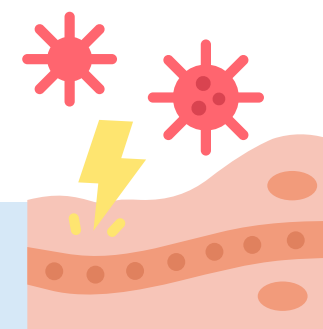
Energieproduktion
Mitochondrien



Schutz
Nervenzellen



Entzündungs-
hemmend



Zirkadianer Rhythmus



Quelle: Li et al., 2026 Exercise as Chronotherapy: Regulating Circadian Rhythms to Alleviate Symptoms in Parkinson's Disease

Quelle: Han et al., 2026. Physical exercise and inflammation in Parkinson's disease: a review. Neurol Sci. 2025 Dec;46(12):6343-6356.

Quelle: Mitchell AK, Bliss RR, Church FC. Exercise, Neuroprotective Exerkines, and Parkinson's Disease: A Narrative Review. Biomolecules. 2024 Sep 30;14(10):1241.

Quelle: Naser AA, et al., 2025 The Effect of Multimodal Exercise on the Levels of BDNF and GDNF in Patients with Parkinson's Disease.

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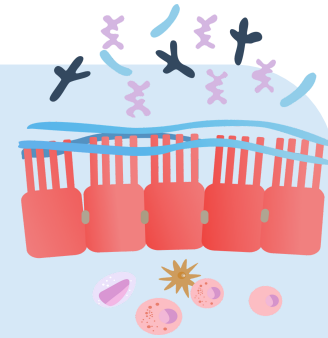


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Stärkere
Darmbarriere



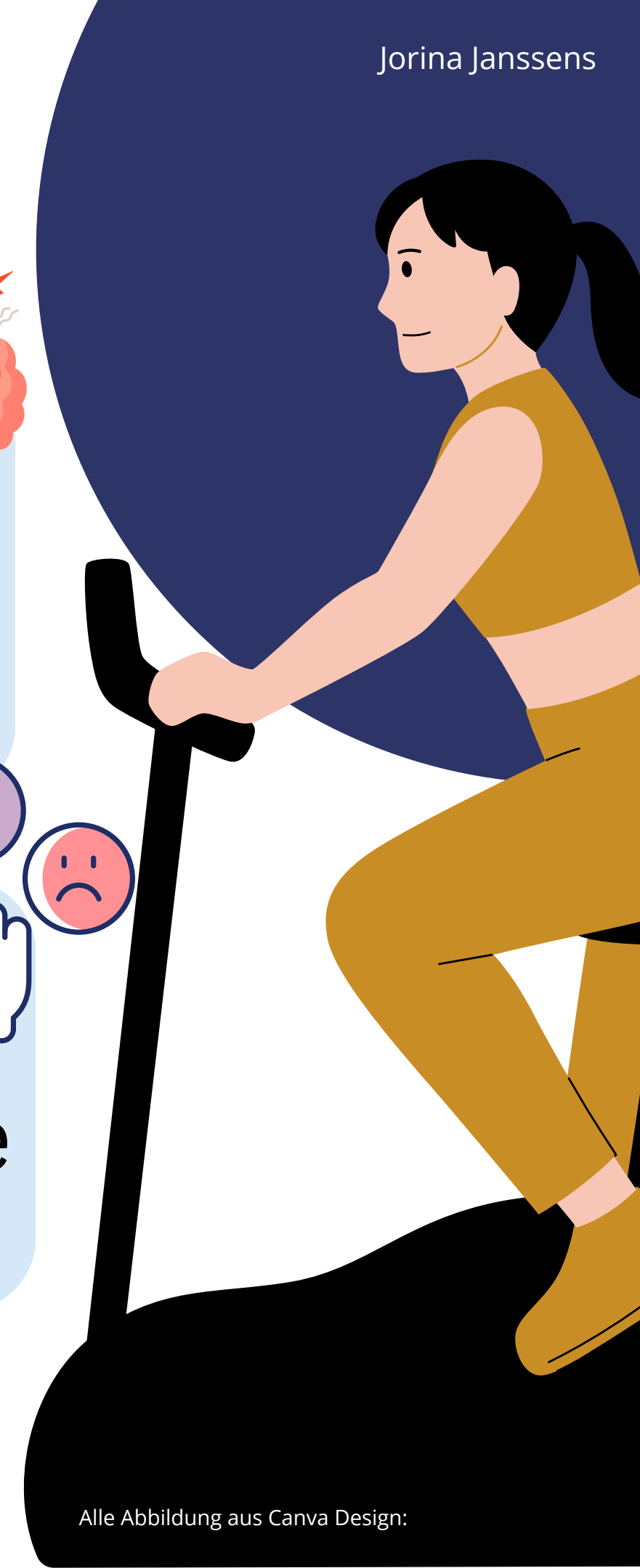
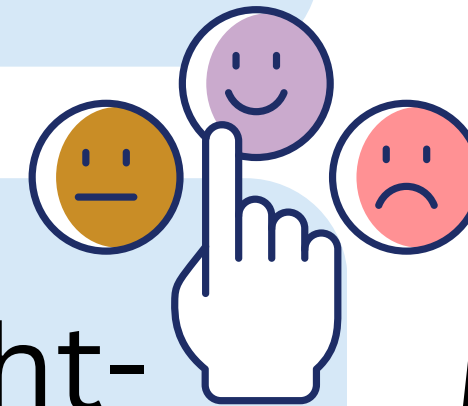
Gedächtnis -
Kognition



Weniger oxidativer
Stress



Stimmung, nicht-
motorische Symptome



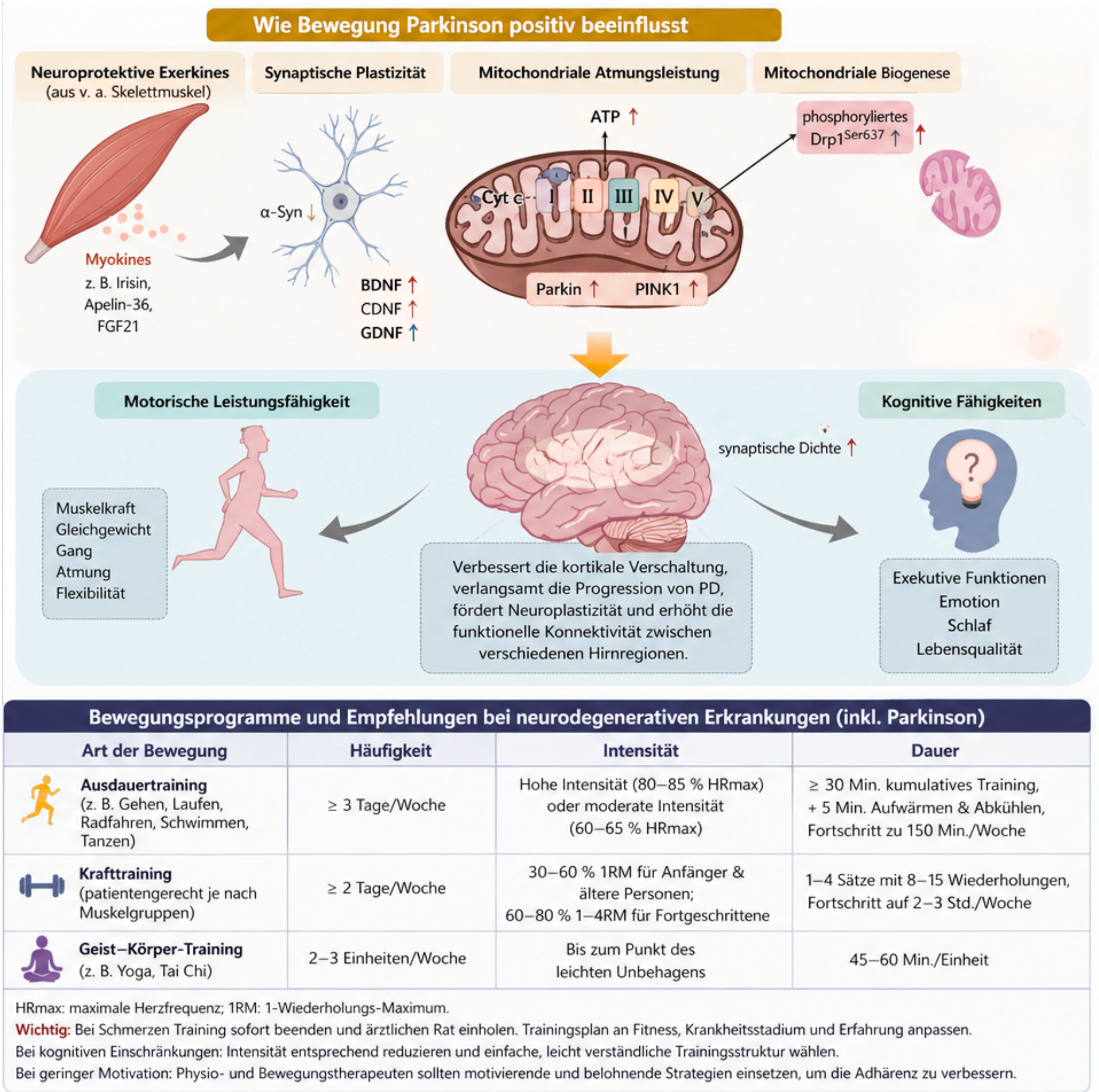
Quelle: Yan et al., 2025. Effects of exercise modalities on cognitive function and depression in patients with Parkinson's disease: A systematic review and network meta-analysis. Geriatr Nurs. 2025
Quelle: Yang et al., 2026. Therapeutic potential of exer kines in neurodegenerative and mental disorders : a narrative review. Front. Physiol. 17:1793043
Quelle: Vargese et al., 2024 : Physical Exercise and the Gut Microbiome: A Bidirectional Relationship Influencing Health and Performance. Nutrients. 2024 Oct 28;16(21):3663
Quelle: Dani C, et al., 2020. Aquatic exercise program-modulated oxidative stress markers in patients with Parkinson's disease.
Quelle: Usha Kiran P, Haria J, Rani R, Singh S. 2026 Mitochondrial dysfunction and oxidative stress in Parkinson's disease: mechanisms, biomarkers, and therapeutic strategies. Tissue Barriers.
Quelle: Costa V, Zambetta ML, Gianlorenço AC 2026. Physical Exercise for Managing Fatigue in Parkinson's Disease: Clinical and Research Recommendations From a Systematic Review and Meta-Analysis.
Quelle: King er SB, et al., 2026. The Relation between Exercise and Non-Motor Symptoms in Parkinson's Disease. Mov Disord Clin Pract. 2.
Quelle: Cyrus Safaeipour, BS et al., 2026 Exercise and Brain Health:Expert Review Lifestyle Medicine and Preventive Neurology

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2 - BEWEGUNG

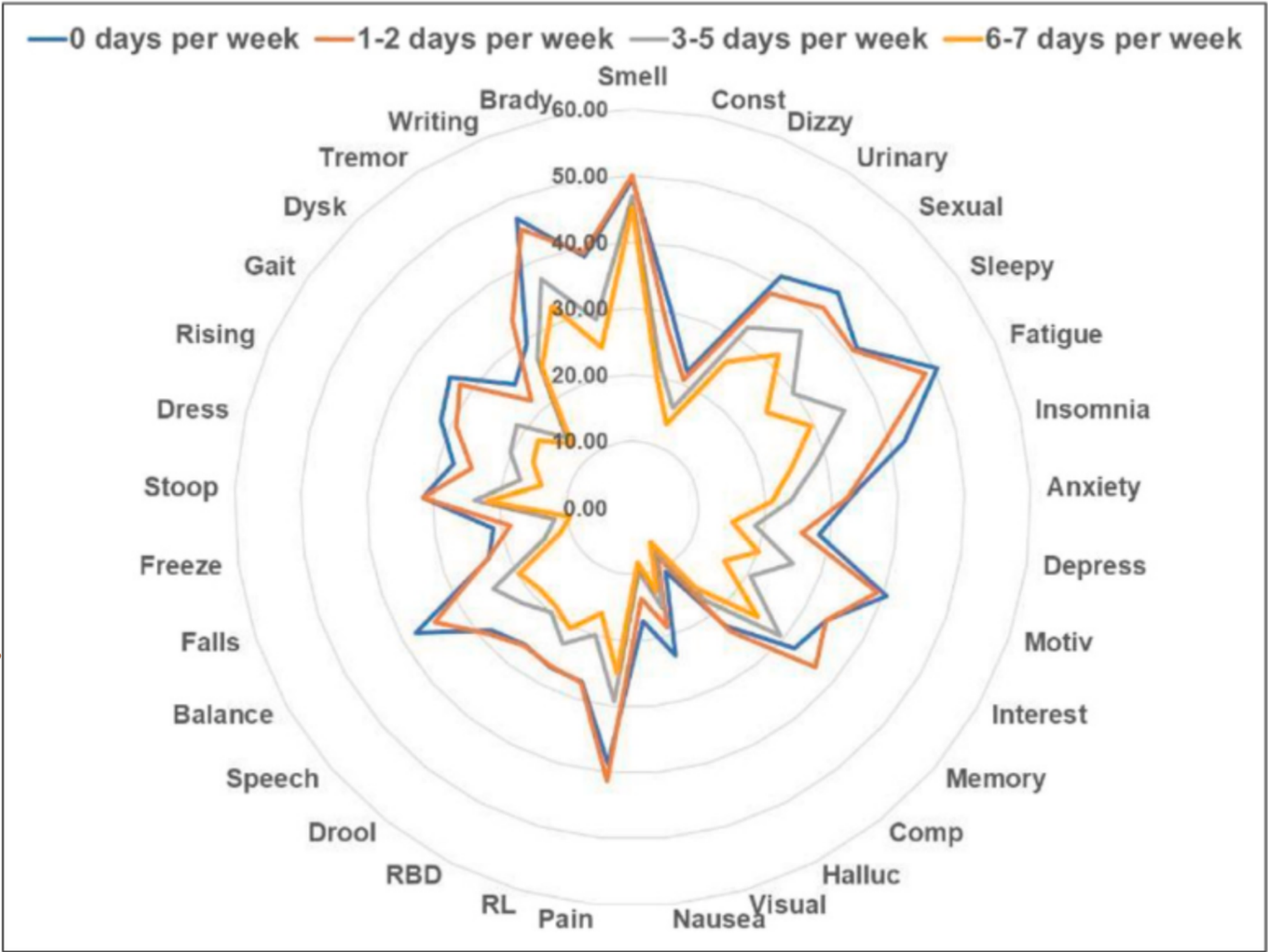
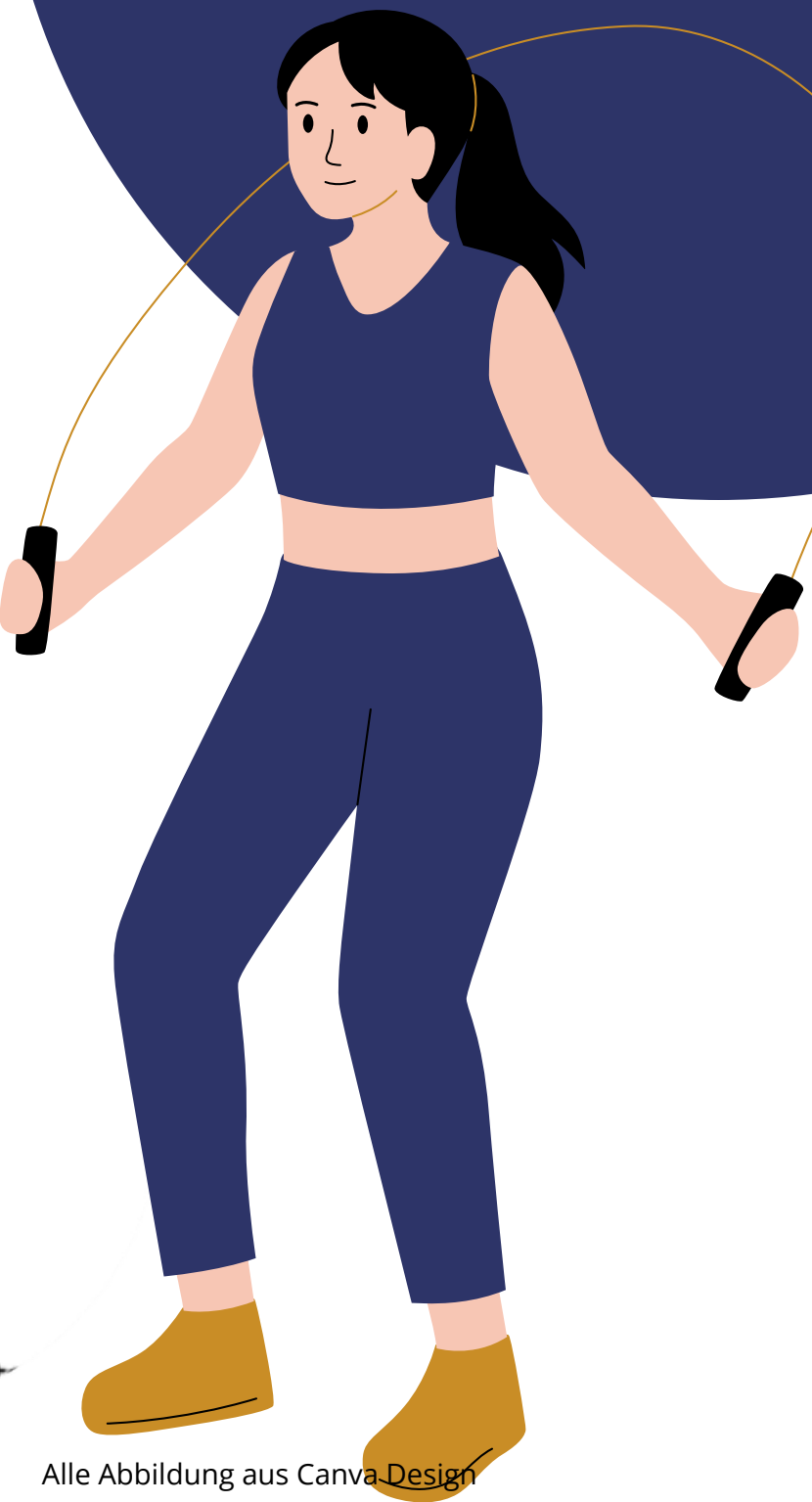


Figure 2. Association between individual Parkinson's disease symptom domains and physical activity levels. Data from Morley, J. F., et al., 2026.

Morley, J. F., et al., 2026. Physical Activity , Patient-Reported Outcomes , and Quality of Life in Parkinson ' s Disease.



Alle Abbildung aus Canva Design



2 - BEWEGUNG

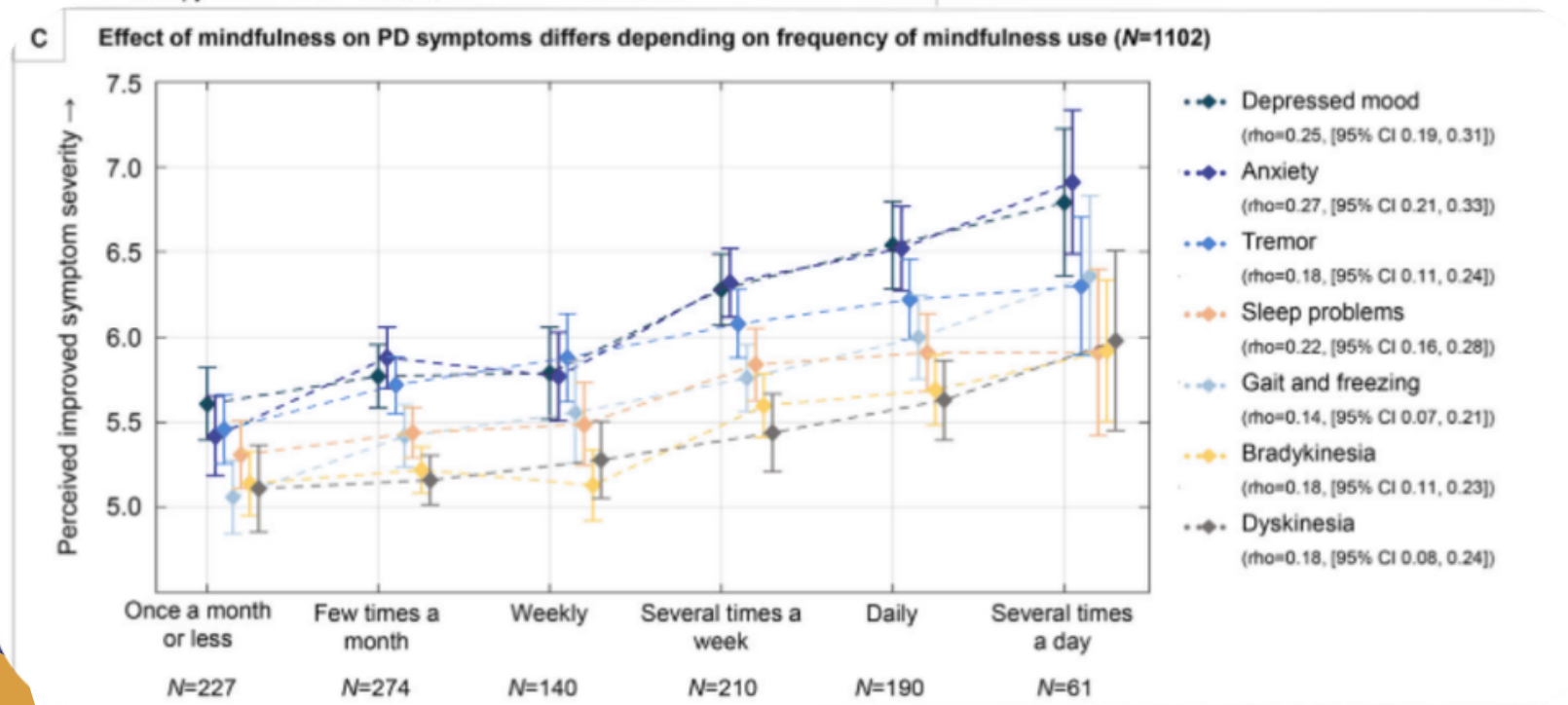
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ARTICLE OPEN

Check for updates

Stress and mindfulness in Parkinson's disease – a survey in 5000 patients

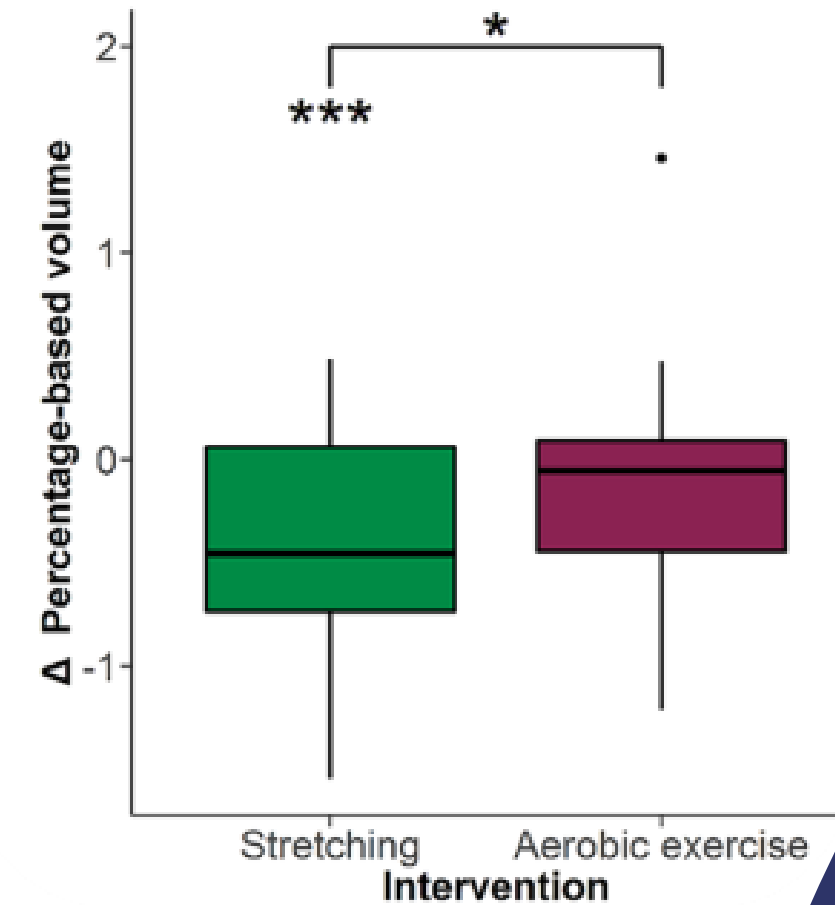
Anouk van der Heide^{1,2}, Anne E. M. Speckens^{1b}, Marjan J. Meinders^{1b}, Liana S. Rosenthal^{1b}, Bastiaan R. Bloem¹ and Rick C. Helmich^{1,2}



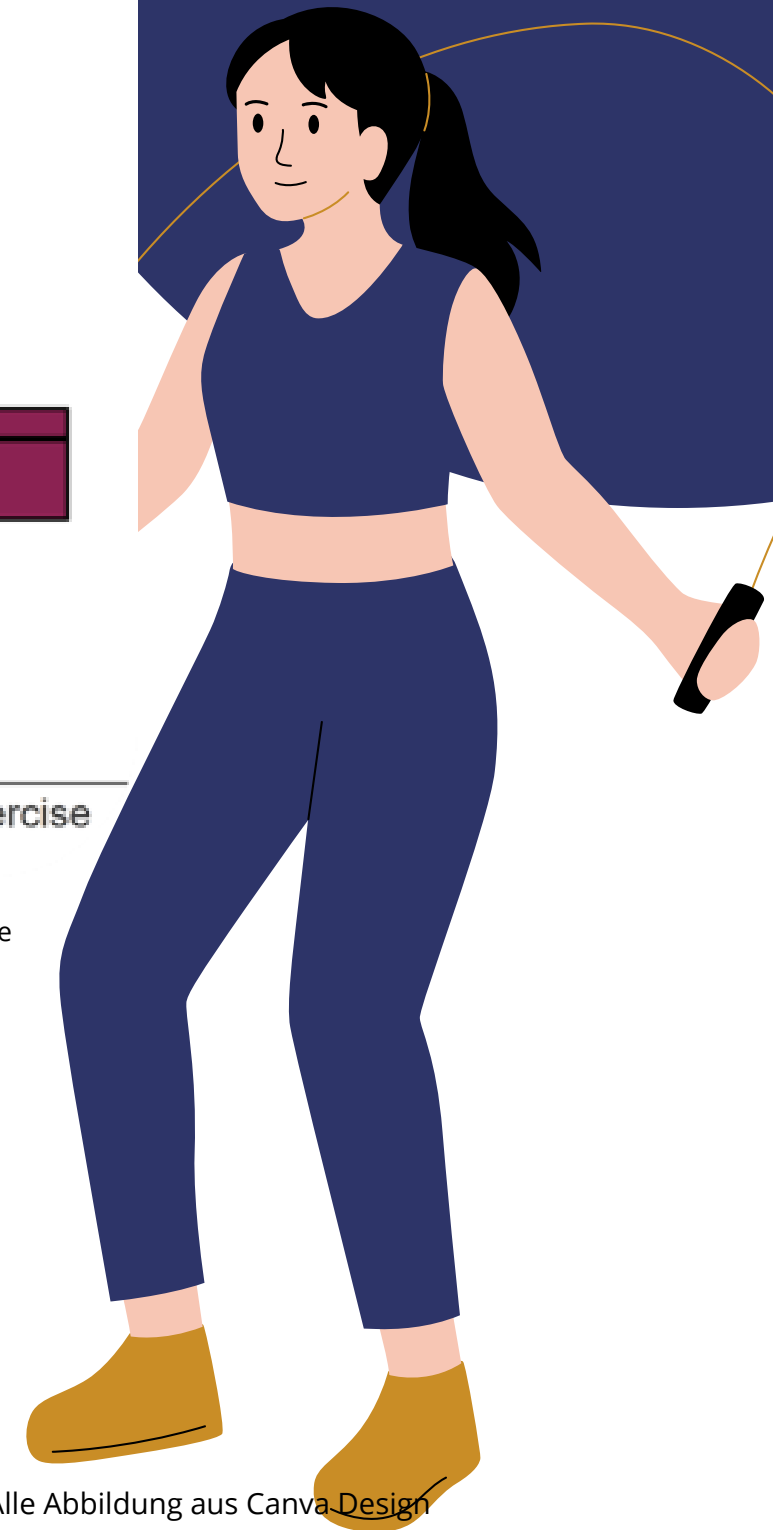
Quelle: van der Heide et al., 2021. Stress and mindfulness in Parkinson's disease – a survey in 5000 patients

A Effect of aerobic exercise on global brain atrophy

Change in global percentage-based volume



Quelle: Johansson, M. E., et al., 2022. Aerobic Exercise Alters Brain Function and Structure in Parkinson's Disease: A Randomized Controlled Trial.



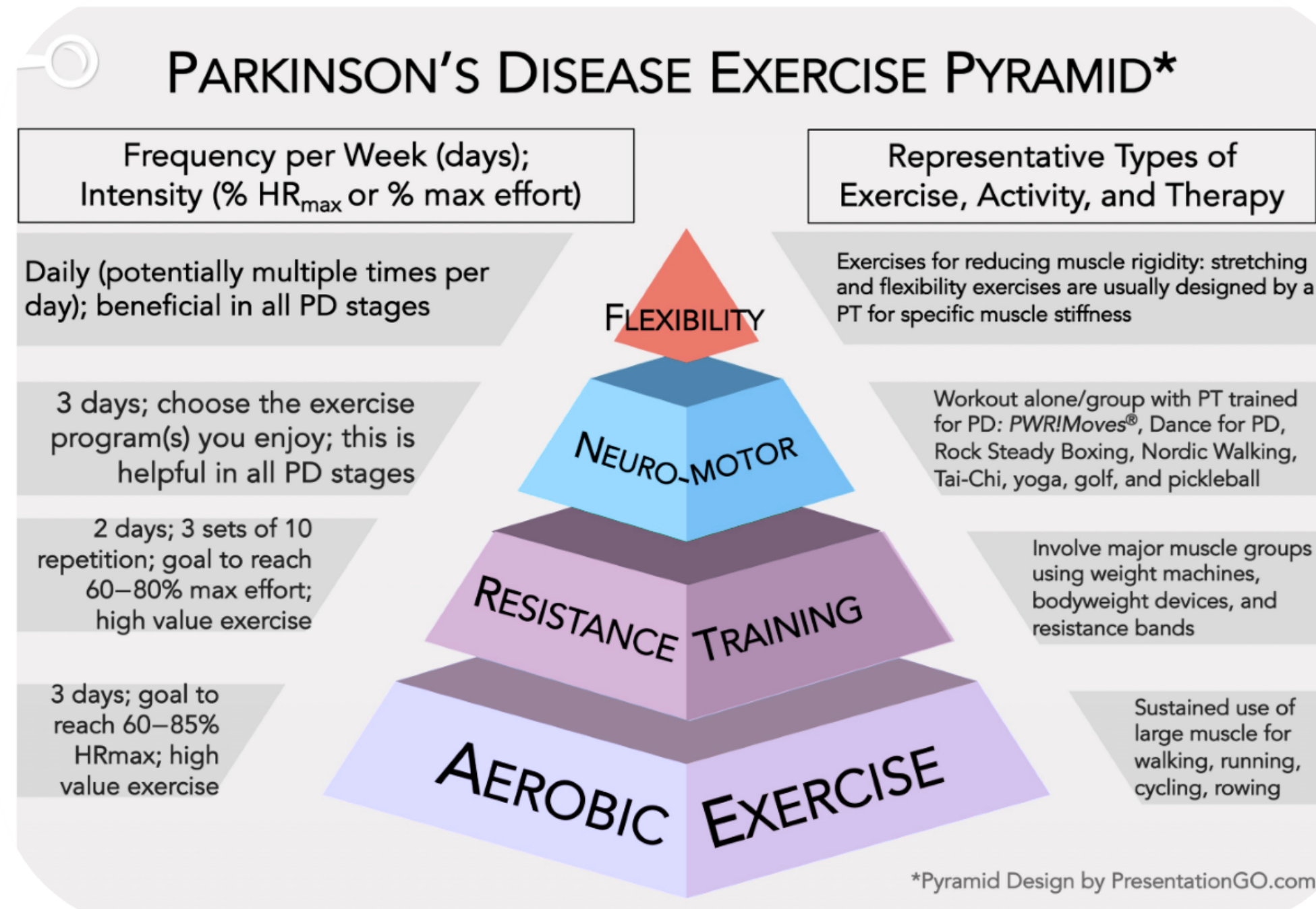
Valton et al., 2026. Physical Exercise for Managing Fatigue in Parkinson's Disease: Clinical and Research Recommendations From a Systematic Review and Meta-Analysis. Journal of Geriatric Physical Therapy
Yan et al., 2025. Effects of exercise modalities on cognitive function and depression in patients with Parkinson's disease: A systematic review and network meta-analysis. Geriatr Nurs. 2025
Kinger SB, et al., 2026. The Relation between Exercise and Non-Motor Symptoms in Parkinson's Disease. Mov Disord Clin Pract.
Kim R, et al., 2025. Moderators of aerobic exercise effects on motor symptoms in patients with Parkinson's disease: A systematic review and meta-analysis. Parkinsonism Relat Disord.
Johansson, M. E., et al., 2022. Aerobic Exercise Alters Brain Function and Structure in Parkinson's Disease: A Randomized Controlled Trial.

Alle Abbildung aus Canva Design

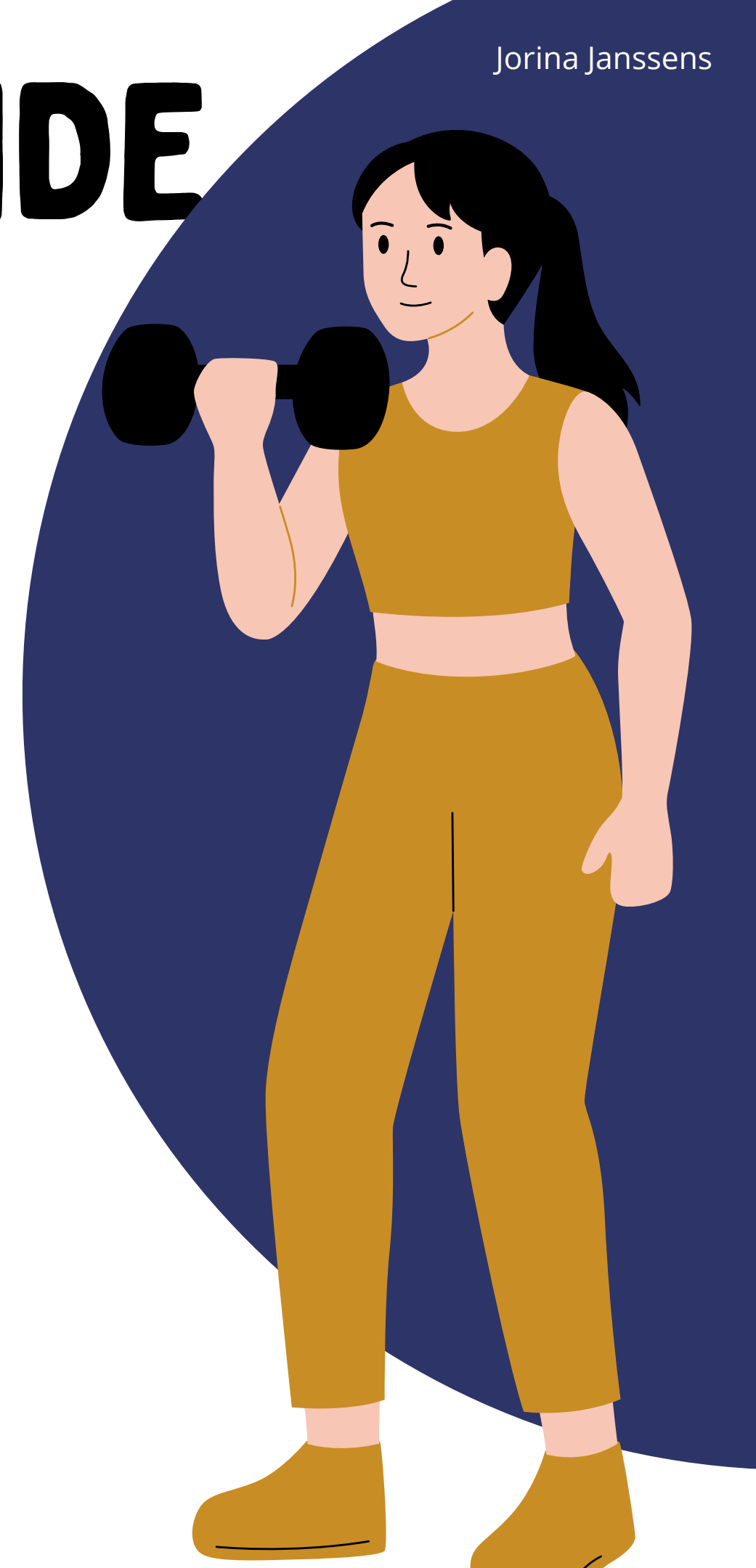


3 - BEWEGUNGSPYRAMIDE

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Quelle: Mitchell, A. K., Bliss, R. R., & Church, F. C. (2024). Exercise , Neuroprotective Exerkines , and Parkinson ' s Disease : A Narrative Review. 1–50.





2 - BEWEGUNGSPYRAMIDE

Hier sind die wichtigste Bewegungsarten die in einem wöchentlichen Plan integriert werden sollten:

1

Ausdauer: 3x/Woche >30Min

Velo (Ergometer), (Nordic) Walking, Tanzen, Aquafitness, Laufband, Joggen. Ohne Sturzgefahr/Blockade: hohe Intensität

2

Kraft: 2x/Woche

Grosse Muskelgruppe (Aufrichtung)
3 Sets von 8-12 Wiederholungen - Aufbau Gewicht
Fitnessraum, Theraband, eigenes Körpergewicht (Klettern)

3

Spass - Koordination

Tanzen, Boxen, Klettern, Federball, Tischtennis, Tai-Chi, ...

4

Body-Mind: 2-3x/Woche -

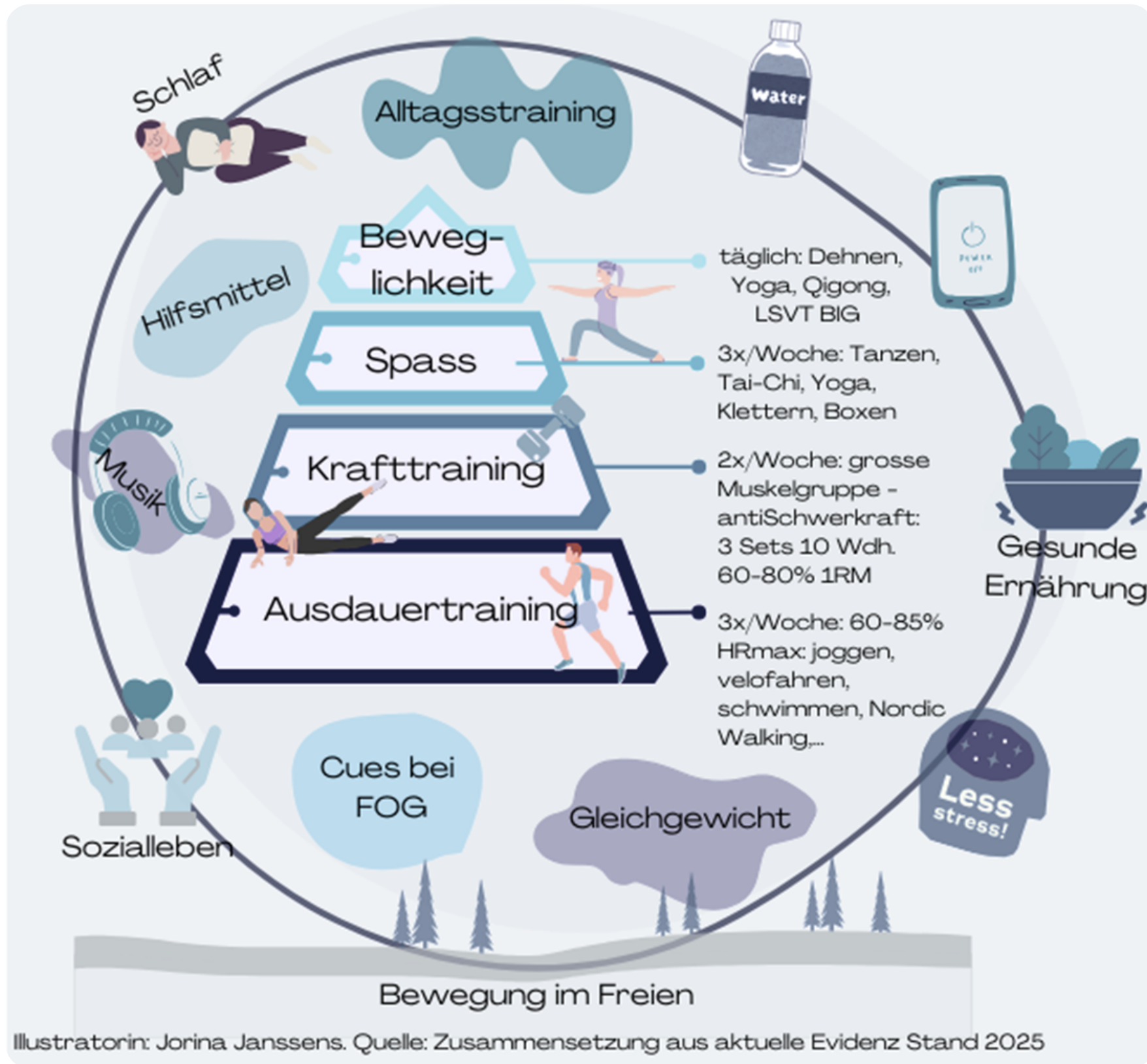
Steifigkeit reduzieren
Dehnen, Yoga, Tai-Chi, Qigong
Streckung, Rotationen + Atmung, Entspannung und Körperwahrnehmung schulen





3 - BEWEGUNGSPYRAMIDE

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Corcos et al., 2024 Advice to People with Parkinson's in My Clinic: Exercise. Journal of Parkinson's Disease

Langeskov-Christen et al., 2024. Exercise as medicine in Parkinson's disease

Mitchell et al., 2024. Exercise , Neuroprotective Exerkines , and Parkinson ' s Disease : A Narrative Review. . Biomolecules.

Abkürzungen: FOG = Freezing of Gait; Wdh = Wiederholungen; RM = Repetition Maximum; HR=Heart Rate

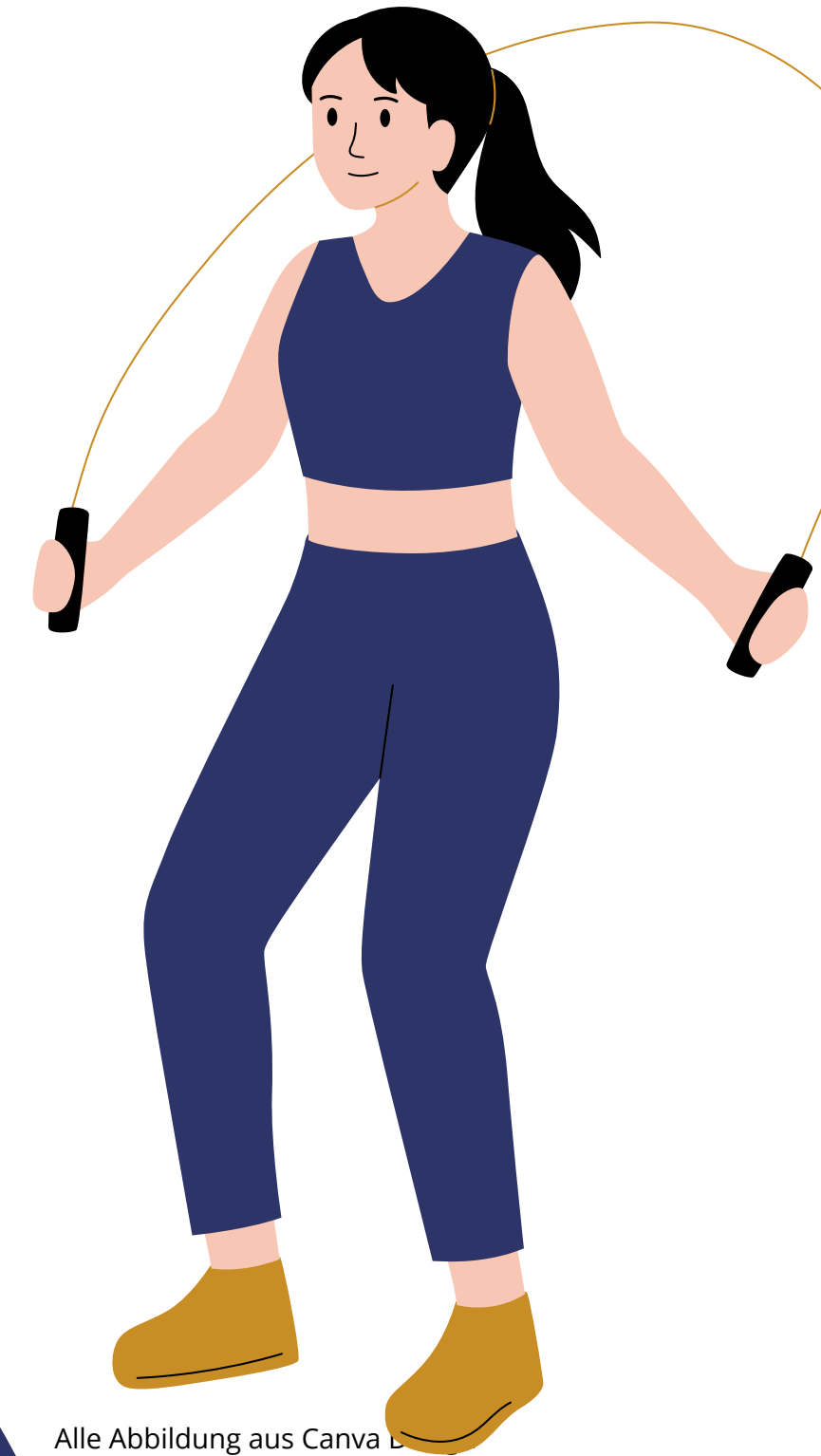
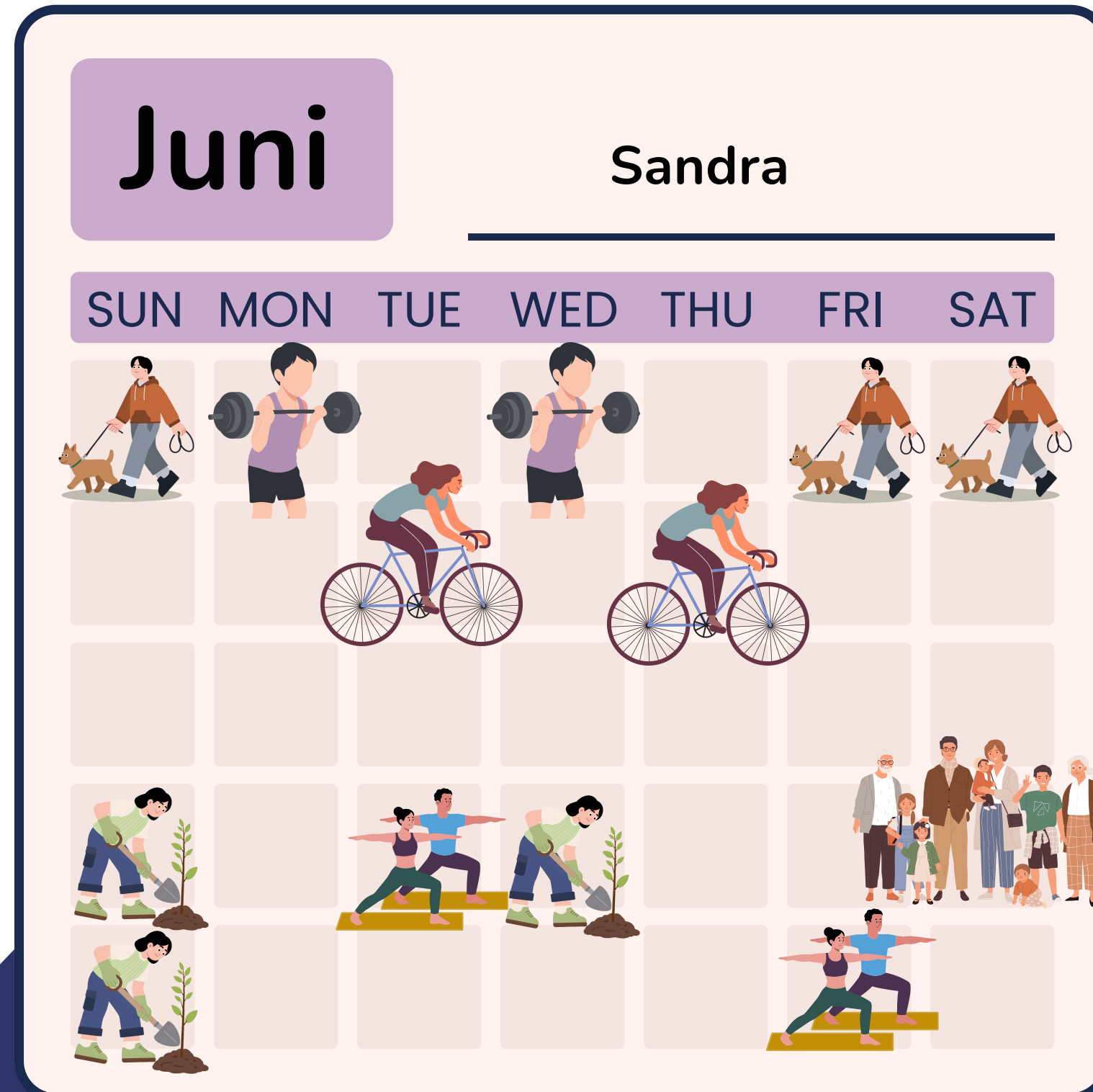
Cools CI, Kotz SA, Bloem BR, de Vries NM, Duits AA. Understanding personal preferences to promote exercise adherence in Parkinson's disease. Clin Park Relat Disord. 2025 Apr 28;12:100336. doi: 10.1016/j.prdoa.2025.100336.

Alle Abbildung aus Canva Design:



3 - BEWEGUNGSPYRAMIDE

- Saisonabhängig
- Familien-Berufstauglich
- Vorliebe - Abneigungen
- Finanziell
- Gruppe / alleine



Alle Abbildung aus Canva



3 - BEWEGUNGSPYRAMIDE

1

HINDERNISSE

Fatigue / Depression

- 20% meint, dass Bewegung Fatigue erhöht
- Bewegungsvermeidung
- Interprofessionelle Therapie

2

HINDERNISSE

Stürze - Gehunsicherheit:

- Mehr Untersützung
- zusätzliche, individuelle Therapie
- Interprofessionelle Therapie





3 - BEWEGUNGSPYRAMIDE

3

HINDERNISSE

Dopamine-Mangel:

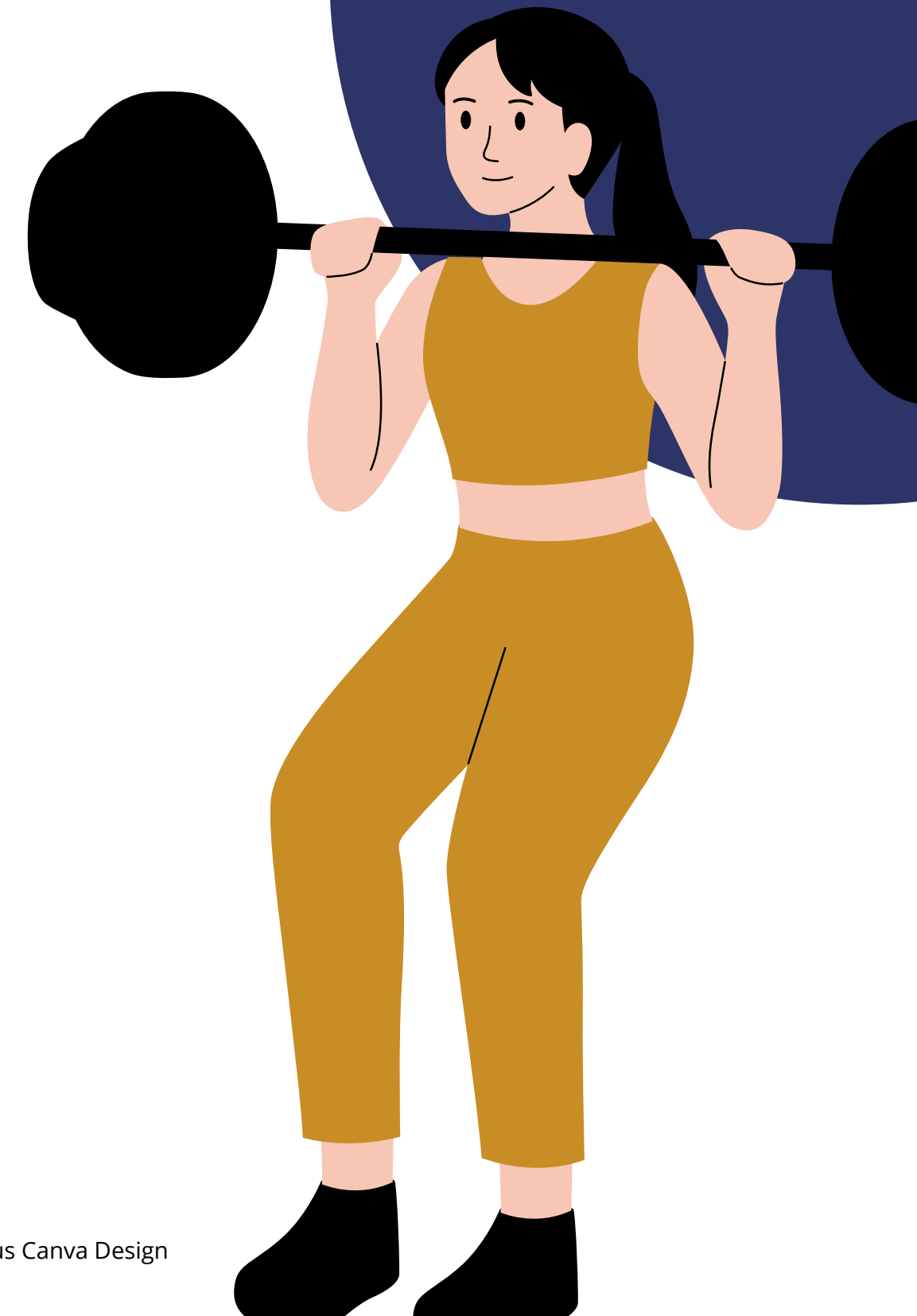
- Antriebslos, Initiativmangel
- Mehr Coaching - Feedback notwendig - Supervision
- Sport in On-Phase
- Interprofessionelle Therapie

4

HINDERNISSE

Kognitive Defizite:

- Hilfe bei Organisation - Durchführung
- Repetition
- Interprofessionelle Therapie



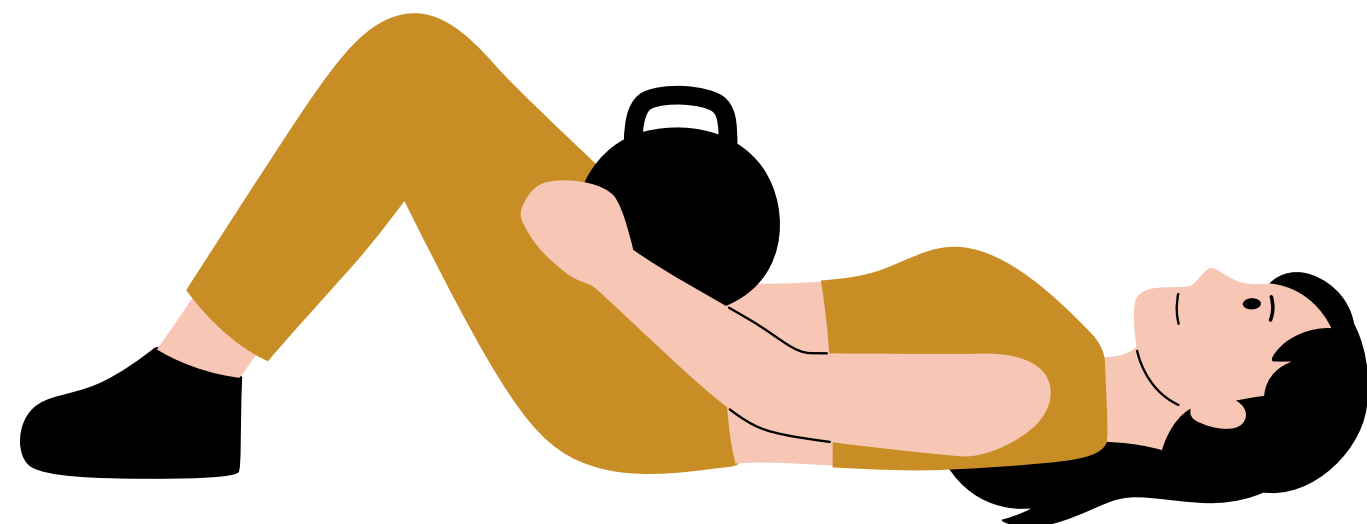


FAZIT

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BEWEGUNG WIRKT

- zentraler Bestandteil der Therapie & lifestyle medicine
- Verlauf + beeinflussen
- Lebensqualität verbessern
- Täglich
- Pyramide beachten



Alle Abbildung aus Canva Design



LINKEDIN

Emily Lane • 3rd+
Managing Partner of Yoga Fitness Center
1d •

people think brain aging starts only in the brain, but research suggests body plays a bigger role than expected. In a 10-year twin study, people with greater leg power in midlife tended to show better cognitive ...more



People with **stronger legs** may **show** better memory, thinking, and brain **health** as they **get** older

Everyday Wisdom

+ Follow



Andrea Herrmann • 2nd

Parkinson's Foundation - Fundraising Events Coordinator, Nort...

6d •

+ Follow

Exercise is a vital part of Parkinson's disease management, helping maintain balance, mobility, flexibility and overall quality of life. However, finding the optimal workout routine with PD is easier said than done. ...more



Research shows that

EXERCISE

improves both motor and

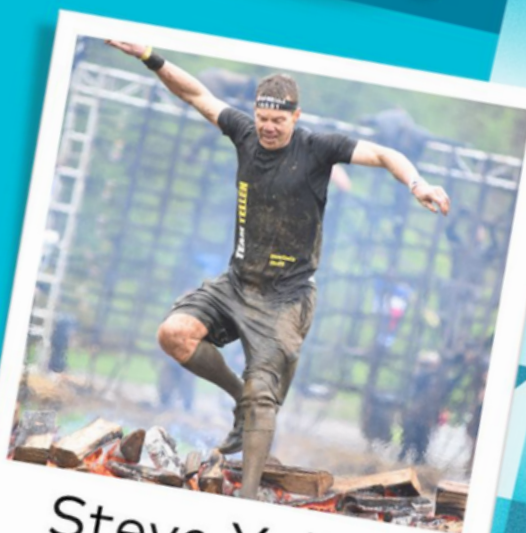
non-motor Parkinson's symptoms



Parkinson's Foundation
29,578 followers
3w •

"My journey isn't defined by a diagnosis — it's defined by how I've chosen to respond," says Steve, who was diagnosed with Parkinson's disease in ...more

My PD Story



Steve Yellen



Prof. Dr. Carsten Eggers • 2nd
Ärztlicher Direktor Neurozentrum, Chefarzt bei Knappschaft KL...
2d •

Welt-Parkinson-Tag 2026 – Aktiv für Betroffene
Am 11. April ist Welt-Parkinson-Tag – ein Tag, der uns daran ...more

Show translation



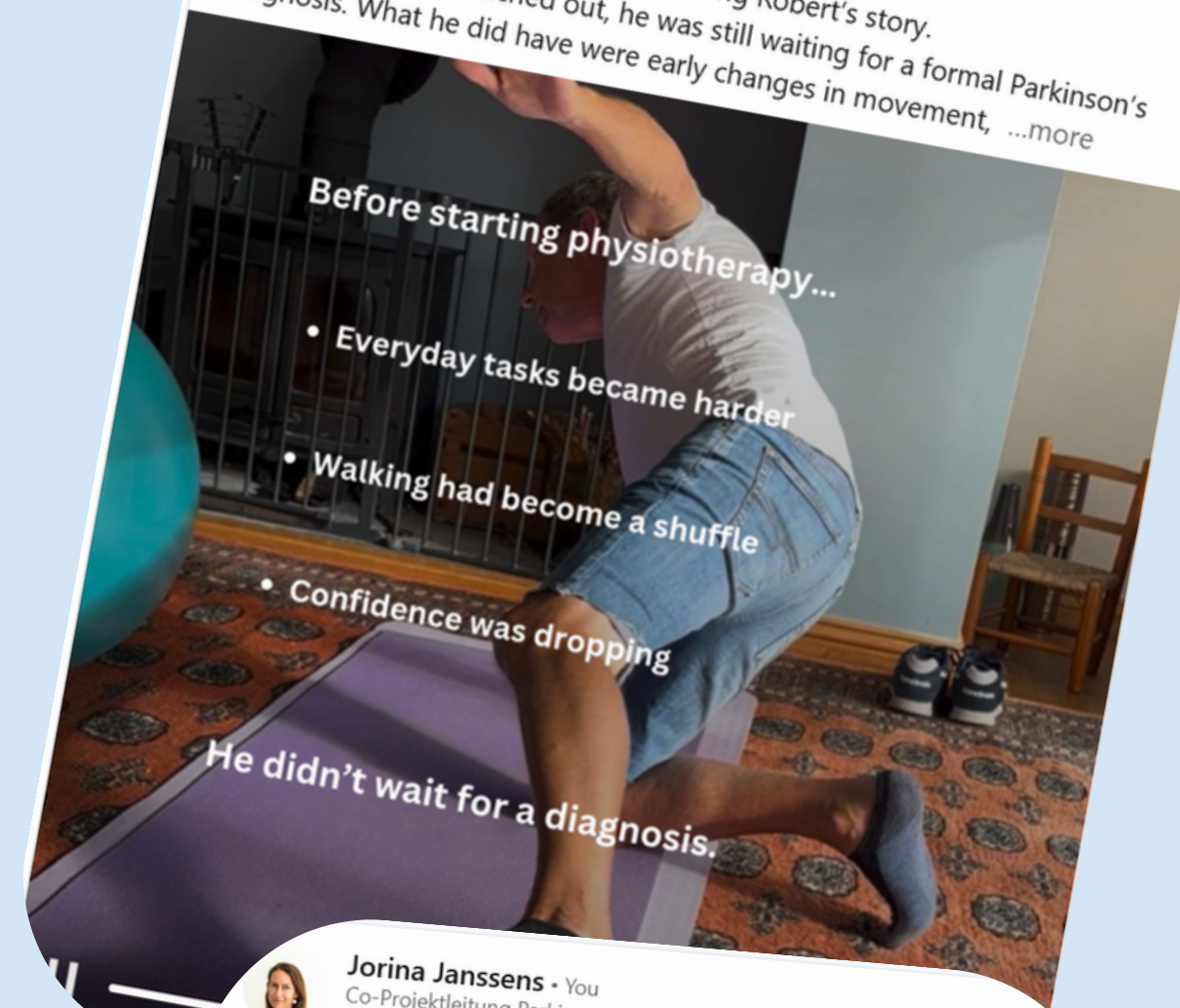
"SIE KÖNNEN ENORM VIEL SELBST TUN"
Prof. Eggers' Botschaft an alle Parkinson-Patienten

”

„Sie können enorm viel selber tun. Bilden Sie sich fort, werden Sie zum Experten Ihrer eigenen Erkrankung.“

Neuroability
385 followers
2d •

This World Parkinson's Day, we're sharing Robert's story. When Robert first reached out, he was still waiting for a formal Parkinson's diagnosis. What he did have were early changes in movement, ...more



Jorina Janssens • You
Co-Projektleitung Parkinson-Guide (SPNM), Parkinsonexpertin, Präsi...
3w •

Einsamkeit bei Parkinson – oft unterschätzt, aber entscheidend
Eine aktuelle Studie von David Andrés González et al. zeigt: Einsamkeit betrifft viele Menschen mit Parkinson. ...more



Parkinsonism and Related Disorders

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

Short communication

Loneliness in Parkinson's disease: Subjective experience overshadows objective motor impairment

David Andrés González^{a,*}, Michelle H.S. Tosin^a, Tila Warner-Rosen^a, Mitra Afshari^{a,b}, Brandon Barton^{a,c}, Jori E. Fleisher^a, Deborah A. Hall^a, Alana E. Kirby^a, Katie Kompolti^a, Abhimanyu Mahajan^{a,d}, Neepa Patel^a, Christina Swan^a, Christopher G. Goetz^a

^a Department of Neurological Sciences, Rush University Medical Center, USA
^b Department of Neurology & Rehabilitation, University of Illinois College of Medicine, USA
^c Parkinson's Disease Research, Education, and Clinical Care Consortium, Jesse Brown VA Medical Center, USA
^d Gardner Center for Parkinson's Disease and Movement Disorders, University of Cincinnati, USA

ARTICLE INFO

Keywords:
Loneliness
Social isolation
Social support
Parkinson's disease
Motor activity
Quality of life

ABSTRACT

Introduction: Loneliness is linked to poor life quality and health, but its relevance in Parkinson's disease (PD) is incompletely understood. The current study aimed to understand rates of loneliness and its determinants in PD. **Methods:** Consecutive cross-sectional sampling resulted in 178 PD subjects (60 % men) across disease stages (86 % early-stage) with gold-standard diagnoses. Loneliness was characterized with two scales, PD was characterized by objective measures, motor ratings, and perceived functional impact, and social-emotional assessment included determined predictors of loneliness in PD, and social-emotional bivariate and robust multivariate regression **Results:** Most participants had concerns, with 64.6 % endorsing high levels of loneliness. PD stage, but not motor impairment or other objective measures, predicted loneliness. In contrast, subjective measures of PD functional impact, social network size, social support, depression, and life space had a significant relationship with loneliness. In multivariate models, depression, PD functional impact, and social network size specifically emerged as most important predictors of loneliness. Although social loneliness was more prevalent, emotional loneliness was more impactful. **Conclusion:** Loneliness is a prevalent and impactful experience in PD, but its relevance to motor outcomes is unclear. Further research is needed to understand the mechanisms linking loneliness to motor outcomes.



REFERENZEN

- Ahern, L., Curtin, C., Timmons, S., Lamb, S. E., & McCullagh, R. (2024). "Exercise... to Me, It's Freedom": Motivation, Support, and Self-Management to Keep Physically Active with Parkinson's Disease: A Qualitative Study. *Geriatrics (Switzerland)*, 9(4). <https://doi.org/10.3390/geriatrics9040092>
- Białoń, mgr N., Górka, dr hab. n. o zdr. D., & Górka, mgr M. (2024). The brain-gut axis: communication mechanisms and the role of the microbiome as a neuroprotective factor in the development of neurodegenerative diseases: A literature overview. *AIMS Neuroscience*, 11(3), 289–311. <https://doi.org/10.3934/neuroscience.2024019>
- Borghammer P, Van Den Berge N. Brain-First versus Gut-First Parkinson's Disease: A Hypothesis. *J Parkinsons Dis*. 2019;9(s2):S281-S295. doi: 10.3233/JPD-191721. PMID: 31498132; PMCID: PMC6839496.
- Brauer, S. G., Lamont, R. M., & O'Sullivan, J. D. (2024). A physiotherapy group exercise and self-management approach to improve physical activity in people with mild-moderate Parkinson's disease: a randomized controlled trial. *Trials*, 25(1), 1–10. <https://doi.org/10.1186/s13063-023-07870-4>
- Burtscher, J., Moraud, E. M., Malatesta, D., Millet, G. P., Bally, J. F., & Patoz, A. (2024). Exercise and gait/movement analyses in treatment and diagnosis of Parkinson's Disease. *Ageing Research Reviews*, 93(November 2023). <https://doi.org/10.1016/j.arr.2023.102147>
- Chen, Y., & Chen, Y. (2024). The impact of combined aerobic and resistance exercise on the prognosis of early Parkinson's disease patients. *Technology and Health Care*, 33(380), 1–10. <https://doi.org/10.3233/thc-240821>
- Cohen, M., Herman, T., Ganz, N., Badichi, I., Gurevich, T., & Hausdorff, J. M. (2023). Multidisciplinary Intensive Rehabilitation Program for People with Parkinson's Disease: Gaps between the Clinic and Real-World Mobility. *International Journal of Environmental Research and Public Health*, 20(5). <https://doi.org/10.3390/ijerph20053806>
- Cools CI, Kotz SA, Bloem BR, Duits AA, de Vries NM. Motivation Matters: Elucidating Factors Driving Exercise in People With Parkinson Disease. *Phys Ther*. 2025 Jun 2;105(6):pzaf048. doi: 10.1093/ptj/pzaf048. PMID: 40207869; PMCID: PMC12131318.
- Corcos, D. M. (2024). Importance of upper and lower body resistance exercise for preventing and reversing sarcopenia in Parkinson's disease. *Parkinsonism and Related Disorders*, 123(page 2), 10–13. <https://doi.org/10.1016/j.parkreldis.2024.106104>
- Corcos, D. M., Lamotte, G., Luthra, N. S., & McKee, K. E. (2024). Advice to People with Parkinson's in My Clinic: Exercise. *Journal of Parkinson's Disease*, 14(3), 609–617. <https://doi.org/10.3233/JPD-230277>
- Cordani, C., & Mosconi, B. (2024). What type of physical exercise works best to improve movement and quality of life for people with Parkinson's disease? - A Cochrane Review summary with commentary. *NeuroRehabilitation*, 54(4), 699–702. <https://doi.org/10.3233/NRE-246004>
- Dani C, Proença IT, Marinho J, Peccin P, da Silva IRV, Nique S, Striebel V, Pochmann D, Elsner VR. Aquatic exercise program-modulated oxidative stress markers in patients with Parkinson's disease. *Neural Regen Res*. 2020 Nov;15(11):2067-2072. doi: 10.4103/1673-5374.276337. PMID: 32394964; PMCID: PMC7716021.
- de Almeida, F. O., Santana, V., Corcos, D. M., Ugrinowitsch, C., & Silva-Batista, C. (2022). Effects of Endurance Training on Motor Signs of Parkinson's Disease: A Systematic Review and Meta-Analysis. *Sports Medicine*, 52(8), 1789–1815. <https://doi.org/10.1007/s40279-022-01650-x>
- de Laat, B., Hoyer, J., Stanley, G., Hespeler, M., Ligi, J., Mohan, V., Wooten, D. W., Zhang, X., Nguyen, T. D., Key, J., Colonna, G., Huang, Y., Nabulsi, N., Patel, A., Matuskey, D., Morris, E. D., & Tinaz, S. (2024). Intense exercise increases dopamine transporter and neuromelanin concentrations in the substantia nigra in Parkinson's disease. *Npj Parkinson's Disease*, 10(1), 1–7. <https://doi.org/10.1038/s41531-024-00641-1>
- De Santis, K. K., & Kaplan, I. (2020). The motor and the non-motor outcomes of Nordic Walking in Parkinson's disease: A systematic review. *Journal of Bodywork and Movement Therapies*, 24(2), 4–10. <https://doi.org/10.1016/j.jbmt.2020.01.003>
- El Hayek, M., Lobo Jofili Lopes, J. L. M., Lelaurin, J. H., Gregory, M. E., Abi Nehme, A. M., McCall-Junkin, P., Au, K. L. K., Okun, M. S., & Salloum, R. G. (2023). Type, Timing, Frequency, and Durability of Outcome of Physical Therapy for Parkinson Disease: A Systematic Review and Meta-Analysis. *JAMA Network Open*, 6(7), E2324860. <https://doi.org/10.1001/jamanetworkopen.2023.24860>
- Ernst, M., Folkerts, A. K., Gollan, R., Lieker, E., Caro-Valenzuela, J., Adams, A., Cryns, N., Monsef, I., Dresen, A., Roheger, M., Eggers, C., Skoetz, N., & Kalbe, E. (2023). Physical exercise for people with Parkinson's disease: a systematic review and network meta-analysis. In *Cochrane Database of Systematic Reviews* (Vol. 2023, Issue 1). <https://doi.org/10.1002/14651858.CD013856.pub2>
- Ernst, M., Folkerts, A. K., Gollan, R., Lieker, E., Caro-Valenzuela, J., Adams, A., Cryns, N., Monsef, I., Dresen, A., Roheger, M., Eggers, C., Skoetz, N., & Kalbe, E. (2024). Physical exercise for people with Parkinson's disease: a systematic review and network meta-analysis. In *Cochrane Database of Systematic Reviews* (Vol. 2024, Issue 4). <https://doi.org/10.1002/14651858.CD013856.pub3>
- Foltynie, T., Bruno, V., Fox, S., Kühn, A. A., Lindop, F., & Lees, A. J. (2024). Medical, surgical, and physical treatments for Parkinson's disease. *Neurology*, 103(1042), 315–324. [https://doi.org/10.1016/S0140-6736\(23\)01429-0](https://doi.org/10.1016/S0140-6736(23)01429-0)
- Haas, A. N., Delabary, M. dos S., Passos-Monteiro, E., Wolffenbuttel, M., Donida, R. G., Casal, M. Z., Zanardi, A. P. J., Rodrigues, L. P., Martini, A., & Sartari, A. (2024). The effects of Brazilian dance, deep-water exercise and nordic walking, pre- and post-12 weeks, on functional-motor and non-motor symptoms in trained PwPD. *Archives of Gerontology and Geriatrics*. <https://doi.org/10.1016/j.archger.2023.105285>
- Han C, Zhang H, Wang Q, Meng P, Hou Y, Zhang Y. Physical exercise and inflammation in Parkinson's disease: a review. *Neurol Sci*. 2023;144(2):10072-10082. doi: 10.1007/s10072-025-08548-2. Epub 2025 Oct 14. PMID: 41085917.
- Hu, S. (2026). Exercise for Non-Motor Symptoms of Parkinson's Disease: An Evidence-Based Review of Clinical Trials, Dosing Conventions, and Mechanisms. *Neuroscience*, 541, 1–12. <https://doi.org/10.1155/nr/7191029>
- Johansson, M. E., Cameron, I. G. M., Van der Kolk, N. M., de Vries, N. M., Klimars, E., Toni, I., Bloem, B. R., & Helmich, R. C. (2022). Aerobic exercise Alters Parkinson's Disease Biomarkers: A Randomized Controlled Trial. *Annals of Neurology*, 91(2), 203–216. <https://doi.org/10.1002/ana.26291>



REFERENZEN

- Kinger SB, Poole LG, Salazar RD, Neargarder S, Ellis TD, Cronin-Golomb A. The Relation between Exercise and Non-Motor Symptoms in Parkinson's Disease. *Mov Disord Clin Pract*. 2026 Apr;13(4):956-963. doi: 10.1002/mdc3.70444. Epub 2025 Nov 14. PMID: 41235580.
- Kim, M., Kim, E., Kim, M., Moon, S. M., Kim, M., Kim, D., Je, S. H., & Kang, H. (2025). Motivators and Barriers Affecting Exercise in Patients With Parkinson's Disease. *Journal of Clinical Neurology (Korea)*, 21(1), 13–20. <https://doi.org/10.3988/jcn.2024.0328>
- Usha Kiran P, Haria J, Rani R, Singh S. Mitochondrial dysfunction and oxidative stress in Parkinson's disease: mechanisms, biomarkers, and therapeutic strategies. *Tissue Barriers*. 2026;14(1):2537991. doi: 10.1080/21688370.2025.2537991. Epub 2025 Aug 14. PMID: 40813952; PMCID: PMC12962276.
- Langeskov-Christensen, M., Franzén, E., Grøndahl Hvid, L., & Dalgas, U. (2024). Exercise as medicine in Parkinson's disease. *Journal of Neurology, Neurosurgery and Psychiatry*, 1077–1088. <https://doi.org/10.1136/jnnp-2023-332974>
- Li, J., Liu, T., & Wei, J. (2026). Exercise as Chronotherapy: Regulating Circadian Rhythms to Alleviate Symptoms in Parkinson's Disease. <https://doi.org/10.1021/acchemneuro.5c00844>
- Li, J., Liu, T., Xian, M., Zhou, K., & Wei, J. (2025). The Power of Exercise: Unlocking the Biological Mysteries of Peripheral-Central Crosstalk in Parkinson's Disease. In *Journal of Advanced Research*. Cairo University. <https://doi.org/10.1016/j.jare.2025.03.001>
- Liu, X., Liu, Y., Liu, J., Zhang, H., Shan, C., Guo, Y., Gong, X., Cui, M., Li, X., & Tang, M. (2024). Correlation between the gut microbiome and neurodegenerative diseases: A review of metagenomics evidence. *Neural Regeneration Research*, 19(4), 833–845. <https://doi.org/10.4103/1673-5374.382223>
- Lorenzo-García, P., Cavero-Redondo, I., de Arenas-Arroyo, S. N., Guzmán-Pavón, M. J., Priego-Jiménez, S., & Álvarez-Bueno, C. (2024). Effects of Physical Exercise Interventions on Balance, Postural Stability and General Mobility in Parkinson's Disease: a Network Meta-Analysis. *Journal of Rehabilitation Medicine*, 56, 1–19. <https://doi.org/10.2340/jrm.v56.10329>
- Mitchell, A. K., Bliss, R. R., & Church, F. C. (2024). Exercise , Neuroprotective Exerkines , and Parkinson ' s Disease: A Narrative Review. 1–50.
- Moratelli, A., Coutinho, A., & Guimarães, D. A. (2026). Can Dance and Yoga Help With the Non-Motor Symptoms of People With Parkinson ' s ? A Systematic Review With Meta- Analysis. 45(1), 97–109. <https://doi.org/10.1177/07334648251328441>
- Morley, J. F., Subramanian, I., Farahnik, J., Grout, L., Salcido, C., Kurtzer, J., & Mischley, L. K. (2026). Physical Activity , Patient-Reported Outcomes , and Quality of Life in Parkinson ' s Disease. 39(1), 14–23. <https://doi.org/10.1177/08919887251346495>
- Naser AA, Dehkordi KJ, Radhi MN, Taghian F, Chitsaz A. The Effect of Multimodal Exercise on the Levels of BDNF and GDNF in Patients with Parkinson's Disease. *Int J Prev Med*. 2025 May 28;16:35. doi: 10.4103/ijpvm.ijpvm_353_24. PMID: 40520030; PMCID: PMC12165611.
- Passos-Monteiro, E., B. Schuch, F., T. Franzoni, L., R. Carvalho, A., A. Gomeñuka, N., Becker, M., Rieder, C. R. M., Andrade, A., G. Martinez, F., S. Pagnussat, A., & A. Peyré-Tartaruga, L. (2020). Nordic Walking and Free Walking Improve the Quality of Life, Cognitive Function, and Depressive Symptoms in Individuals with Parkinson's Disease: A Randomized Clinical Trial. *Journal of Functional Morphology and Kinesiology*, 5(4), 82. <https://doi.org/10.3390/jfkm5040082>
- Pongmala, C., Stonsaovapak, C., Luker, A., Griggs, A., Van Emde Boas, M., Haus, J. M., & Bohnen, N. I. (2024). Association of Specific Leg Muscle Strength and Motor Features in Parkinson's Disease. *Parkinson's Disease*, 2024. <https://doi.org/10.1155/2024/5580870>
- Salse-Batán, J., Sanchez-Lastra, M. A., Suarez-Iglesias, D., Varela, S., & Ayán, C. (2022). Effects of Nordic walking in people with Parkinson's disease: A systematic review and meta-analysis. *Health and Social Care in the Community*, 30(5), e1505–e1520. <https://doi.org/10.1111/hsc.13842>
- Santiago, J. A., & Potashkin, J. A. (2023). Physical activity and lifestyle modifications in the treatment of neurodegenerative diseases. *Frontiers in Aging Neuroscience*, 15. <https://doi.org/10.3389/fnagi.2023.1185671>
- Song, H., Ge, S., Li, J., Jiao, C., & Ran, L. (2025). Effects of aerobic and resistance training on walking and balance abilities in older adults with Parkinson's disease: A systematic review and meta-analysis. *PloS One*, 20(1), e0314539. <https://doi.org/10.1371/journal.pone.0314539>
- Süß, P., Regensburger, M., Gassner, H., & Winkler, J. (2026). Lifestyle medicine in Parkinson ' s disease. 279–295.
- Tibor Hortobagyi, Kruuse, C., Liu-ambrose, T., Rad, Z., Johansson, H., Cezar, P., & Franz, E. (2023). The impact of aerobic and resistance training on markers of neuroplasticity in health and disease Tibor Hortob a. *Ageing Research Reviews*, 80(July 2022). <https://doi.org/10.1016/j.arr.2022.101698>
- Trinh, J., Vries, N. M. De, Chan, P., Dekker, M. C. J., Helmich, R. C., & Bloem, B. R. (2026). The role of lifestyle interventions in symptom management and disease modification in Parkinson ' s disease. *The Lancet Neurology*, 25(1), 90–102. [https://doi.org/10.1016/S1474-4422\(25\)00305-9](https://doi.org/10.1016/S1474-4422(25)00305-9)
- van der Heide, Anouk, Speckens, Anne E. M., Meinders, Marjan J., Rosenthal, Liana S., Bloem, Bastiaan R., Helmich, Rick C. Stress and mental health in Parkinson's disease: a survey in 5000 patients. *npj Parkinson's Disease* (2021) 7:7 <https://doi.org/10.1038/s41531-020-00152-9>
- Varghese, S., Rao, S., Khattak, A., Zamir, F., & Chaari, A. (2024). Physical Exercise and the Gut Microbiome: A Bidirectional Relationship Promoting Health. *Frontiers in Microbiology*, 15. <https://doi.org/10.3389/fmicb.2024.1213663>
- Wang, W. (2026). Exploring the molecular mechanisms by which exercise improves cognitive impairment in Parkinson ' s disease. *Frontiers in Molecular and Cellular Neuroscience*, 10. <https://doi.org/10.3389/fmnc.2026.1750505>



REFERENZEN

Yan HL, Li MM. Effects of exercise modalities on cognitive function and depression in patients with Parkinson's disease: A systematic review and network meta-analysis. *Geriatr Nurs.* 2025 Nov-Dec;66(Pt C):103683

Yang S, Sang H-W, Kim S, Cho E-J, Choi Y, Kang DW, Jang YC, Park D-H, Kwak H-B and Yook JS (2026) Therapeutic potential of exer kines in neurodegenerative and mental disorders: a narrative review. *Front. Physiol.* 17:1793043. doi: 10.3389/fphys.2026.1793043

Xu G, Ma C and Yang Y (2025) Intervention strategies for Parkinson's disease: the role of exercise and mitochondria. *Front. Aging Neurosci.* 17:1519672. doi: 10.3389/fnagi.2025.1519672

Li W-Q, Yang J-H, Liu L-L, Ding S-T, Yu B, Jiang L, Yan N and Liu H-D (2025) Exercise as a multitarget therapy: modulating myokines, neurotrophins, and inflammation in Parkinson's disease. *Front. Aging Neurosci.* 17:1580029. doi: 10.3389/fnagi.2025.1580029

Zeng, B., Lu, Z., Xin, X., Kong, Z., & Xie, J. (2026). BMC Sports Sci Med Rehabil Article in Press The effects of aerobic exercise on quality of life and motor function in patients with Parkinson ' s disease: a systematic review and meta-analysis IN AR IN.

Zeng, B., Wang, H., Chen, J., Wu, S., & Xie, J. (2026). Optimal exercise modalities and doses for improving quality of life in patients with Parkinson ' s disease: a network meta - analysis and dose – response study.

Zhang, M., Li, F., Wang, D., Ba, X., & Liu, Z. (2023). Exercise sustains motor function in Parkinson's disease: Evidence from 109 randomized controlled trials on over 4,600 patients. *Frontiers in Aging Neuroscience*, 15, 1071803. <https://doi.org/10.3389/fnagi.2023.1071803>

