What can psychometrics tell us about multiple sclerosis?

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Introduction

- Psychometrics: measurement of the psychological status of people
- Psychology includes affect, cognition, motivation, and behavior (as well as sensation)
- Examples of psychometrics depression and anxiety that are numerically captured through the use of scales and surveys
- Psychometrics are discussed colloquially when people talk about being more intellectual or feeling, introverts or extraverts, …
- Psychometrics help us compare how [depressed, happy, etc.] different people are
- We can also compare groups!

Active learning vs. passive social engagement

- Park et al. (2013): three cognitively-demanding conditions (learning to quilt, digital photography, both); one social condition
- Ages 60-90: to strengthen memory, engaged with tasks higher in cognitive load and novelty
- Stronger effect in learning than social condition
- *M* age 56: diverse activities predicted healthier cognition (Lee et al., 2021)

Wadyka & Seaver (2024, p. 17)

Exercise & diet

Koganti (2024)

- Random control trial tested Mediterranean-DASH (Dietary Approaches to Stop Hypertension) Intervention for Neurodegenerative Delay (MIND) (Liu et al., 2021)
- Diet: leafy greens, other veggies, nuts, beans, chicken, fish, berry
- Adults mostly w/ body-mass index of ≥25 kilograms/square-meter, at-risk for Alzheimer's, from Chicago and Boston
- Exercise releases neurotrophic, BDNF (Sleiman et al., 2016)
- Chocolate flavonoids can boost cognition (Socci et al., 2017)

The brain itself

- Big part of neuroplasticity: neurogenesis in hippocampus (Toricelli et al., 2021; Erickson et al., 2014)
- Preliminary result for neurogenesis: consuming hericenone and erinacine chemicals from *Hericium erinaceus* (Lai et al., 2013), a.k.a. lion's mane mushroom (available as capsule, tablet, powder supplement)
- Nerve growth factor->BDNF creation and myelin creation: anti-multiple sclerosis (MS) (Acosta et al., 2013)

Current active MS trials

- 30 studies (“Multiple Sclerosis Clinical Trials”, 2024)
- Ofatumumab injection and siponimod, aspirin (fatigue), stem cell transplanting, MD1003
- SAR442168 to delay disability and its relation to cognitive performance, physical function, quality of life (Dr. Mark Keegan)
- Gray matter (not just white matter)
- Experience and meaning for patients
- Cerebrospinal fluid (Dr. Sean Pittock)
- Sex differences

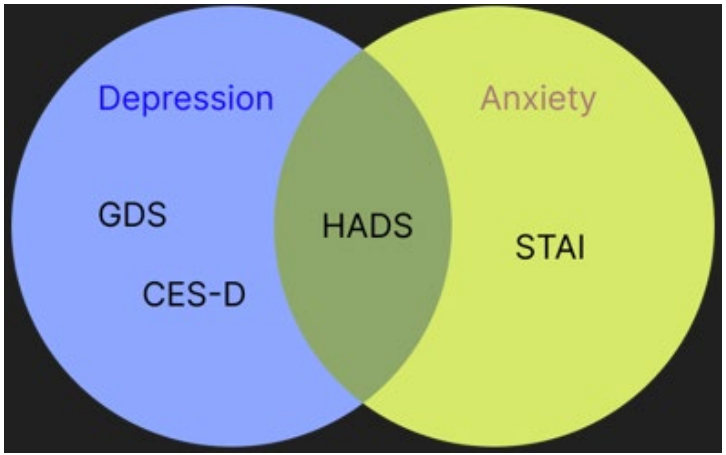
Psychometrics for MS

- What can psychometrics tell us about the whole patient?
- Psychometrics is related to statistics (Batchelder, 2010)
- *Psycho-* and *–metrics*: quantitative measurement of respondent's psychological status
- E.g.: life satisfaction (a wellbeing metric)

Two MS scales

- EDSS: Expanded Disability Status Scale
  - Kurtzke (1983)
  - 20 items
  - Functional systems, walking/needs for mobility assistance, daily activity, communication
  - Scoring: 0.5 per item; score of 0 means “normal”, 5 or 6 “maximal impairment”, 10 death from MS
- MSFC: Multiple Sclerosis Functional Composite
  - Alternative disability scale
  - Created by National MS Society (NMSS) Clinical Outcomes Assessment Task Force in 1994 (Tiftikçioğlu, 2018)
    - Psychologists, neurologists, biostatisticians and epidemiologists
  - Measures ambulation, upper-limb function, cognitive function

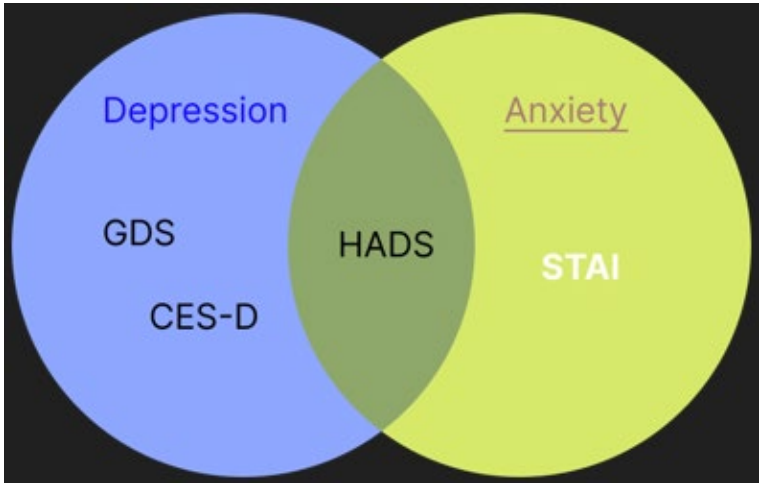
Further psychometric tools



- PHQ-9/Primary Care Evaluation of Mental Disorders (PRIME-MD) (Beswick et al., 2022)
- Depression (and suicidality) screening of prior two weeks
- Multiple sclerosis impact scale (MSIS-29) (van der Linden et al., 2005)
- Perceived Stress Scale (PSS) (Wu & Amtmann, 2013)
- STAI, HADS, GDS, CES-D

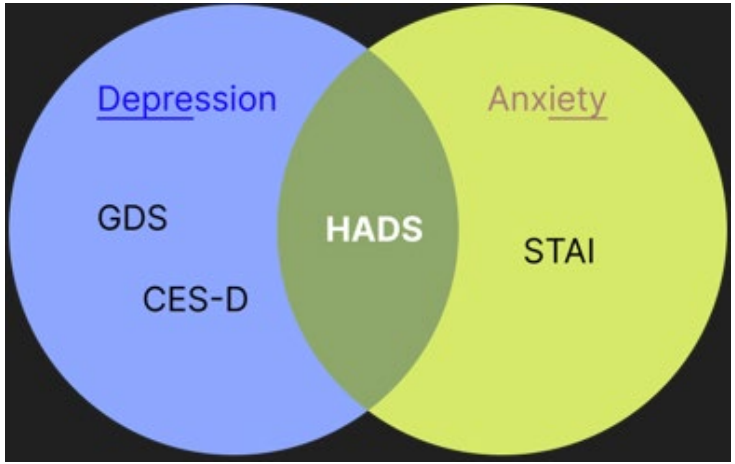
Spielberger State—Trait Anxiety Inventory (STAI)

- Marteau & Bekker (1992)
- Short form: six items (STAI-6); long form: 40; short-form: three items on affect (other three on “being”)
- Long form: two 20-item questionnaires
- Measures present anxiety and general anxiety
- STAI-6 has passable reliability and was found to be valid
- Sample: pregnant females, studying nurses, med students
- Good sample with respect to STAI’s use in medical context—could be extended to include patients such as those with MS

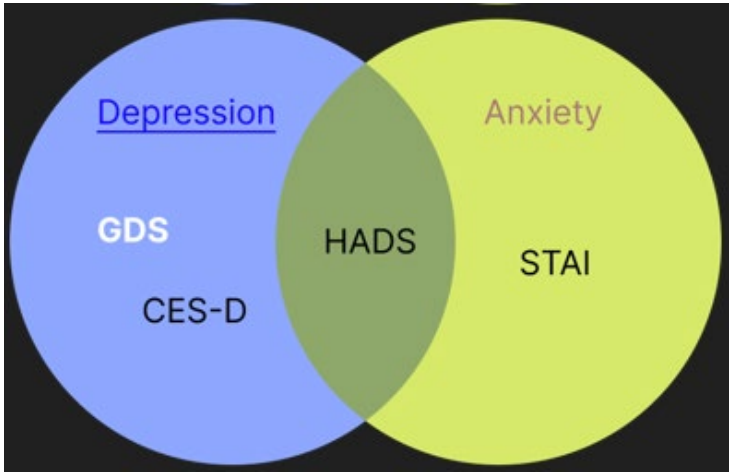


The Hospital Anxiety and Depression Scale

- Zigmond & Snaith (1983)
- 14 items about affect (feeling, enjoyment, humor, …), one about cognition
  - 7 each corresponding to depression and anxiety
  - “normal”, “borderline (case)”, “abnormal (case)” score ranges (0-7, 8-10, 11-21 respectively)
- Used for general population
  - Reliable for ages 65-80 (Djukanovic et al., 2017)
  - Valid for emergency Arabic sample (Al Aseri et al., 2015)
- Used globally and in all healthcare settings; available in at least eight non-English languages (these versions are also reliable and valid)



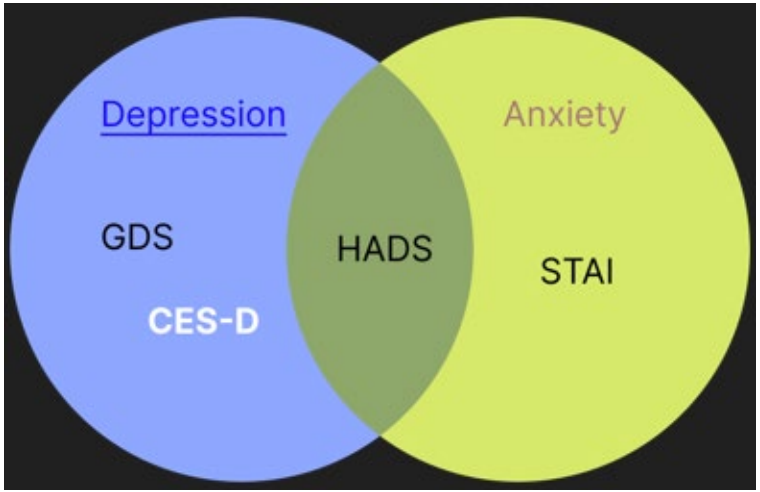
Geriatric Depression Scale (GDS)



- Yesavage & Sheikh (1986)
- For elderly population
- Short form: 15 questions
  - Measures life satisfaction, affect (nine items), cognition (two items) from previous week
    - Question examples: “Do you often get bored?”; “Are you in good spirits most of the time?”
  - If >5 “yes” responses on scale: indicates depression
- Long form: 30 questions
- Demonstrated validity in various studies

CES-D scale

- Center for Epidemiological Studies Depression Scale
- Radloff (1977); for general population
- 10 items on affect, two on cognition
- Decent reliability (test-retest), strong validity (construct) (Goto et al., 2024)
- Last used alongside sleep quality index and social support survey (Chen et al., 2024)
- This scale has stood the test of time with extensive use



Conclusion

- Bias toward depression and affect (vs. cognition) across STAI, HADS, GDS, and CES-D
- Most of above scales' items concern affectIn addition to depression and anxiety, what other factors matter for those with MS?
- Life satisfaction, wellbeing, quality of life (Ruban et al., 2021)
- Psychometrics can inform us of how populations are feeling (and thinking) so we can create a better model of how to reach wellbeing and brain healthiness for each patient.
- Directions of prediction or causality (does bowel/bladder dysfunction cause negative affect? Can psychometrics predict disability type/level?)
- Any special psychological metrics for MS patients (viz., not usual clinical or wellbeing categories)?

References

Acosta, C. M. et al. (Dec. 2013). “Exploring the role of nerve growth factor in multiple sclerosis: implications in myelin repair”. *CNS & neurological disorders drug targets*, *12*(8), 1242–1256. URL: https://doi.org/10.2174/18715273113129990087

Al Aseri, Z. A. et al. (2015). Reliability and validity of the Hospital Anxiety and Depression Scale in an emergency department in Saudi Arabia: a cross-sectional observational study. *BMC emergency medicine*, *15*, 28. URL: https://doi.org/10.1186/s12873-015-0051-4

Batchelder, W. (2010). “Cognitive Psychometrics”. In: *Measuring Psychological Constructs.*

Beswick, E., et al. (Nov. 2022). “The Patient Health Questionnaire (PHQ-9) as a tool to screen for depression in people with multiple sclerosis: a cross-sectional validation study”. *BMC psychology*, *10*(1), 281. URL: https://doi.org/10.1186/s40359-022-00949-8

Djukanovic, I. et al. (Oct. 2017). “Is the Hospital Anxiety and Depression Scale (HADS) a valid measure in a general population 65-80 years old? A psychometric evaluation study”. *Health and quality of life outcomes*, *15*(1), 193. URL: https://doi.org/10.1186/s12955-017-0759-9

Erickson, K. I. et al. (May 2014). “Physical activity, fitness, and gray matter volume”. *Neurobiological aging*, *35 Suppl 2*, S20–S28. URL: https://doi.org/10.1016/j.neurobiolaging.2014.03.034

Goto, Y. et al. (2024). In: *Individual Differences in Addictive Behaviors*, 116.

Koganti, S. (Jan. 2024). “MIND Diet: How It Works, Food List, Recipes, And Risks”. *Stylecraze*. URL: https://www.stylecraze.com/wp-content/uploads/2023/09/MIND-Diet.jpg

Kurtzke J. F. (Nov. 1983). “Rating neurologic impairment in multiple sclerosis: an expanded disability status scale (EDSS)”. *Neurology*, 33(11):1444-52. doi: 10.1212/wnl.33.11.1444. PMID: 6685237.

Lai, P. L. et al. (2013). “Neurotrophic properties of the Lion's mane medicinal mushroom, *Hericium erinaceus* (Higher Basidiomycetes) from Malaysia”. *International journal of medicinal mushrooms*, *15*(6), 539–554. URL: https://doi.org/10.1615/intjmedmushr.v15.i6.30

Lee, S. et al. (Jun. 2021). “Change Is Good for the Brain: Activity Diversity and Cognitive Functioning Across Adulthood”. *The journals of gerontology. Series B, Psychological sciences and social sciences*, *76*(6), 1036–1048. URL: https://doi.org/10.1093/geronb/gbaa020

Liu, X. et al. (Mar. 2021). “Mediterranean-DASH Intervention for Neurodegenerative Delay (MIND) study: Rationale, design and baseline characteristics of a randomized control trial of the MIND diet on cognitive decline”. *Contemporary clinical trials*, *102*, 106270. URL: https://doi.org/10.1016/j.cct.2021.106270

Marteau, T. M. & Bekker H. (Sept. 1992). “The development of a six-item short-form of the state scale of the Spielberger State—Trait Anxiety Inventory (STAI)”. British *Journal of Clinical Psychology*, *31*(3), 276. URL: https://doi.org/10.1111/j.2044-8260.1992.tb00997.x

“Multiple Sclerosis Clinical Trials”. (2024). *Mayo Clinic*. URL: https://www.mayo.edu/research/clinical-trials/diseases-conditions/multiple-sclerosis

Park, D. C. et al. (Nov. 2013). “The impact of sustained engagement on cognitive function in older adults: the Synapse Project”. *Psychological science*, *25*(1), 103–112. URL: https://doi.org/10.1177/0956797613499592

Radloff, L. S. (Jun. 1977). “The CES-D Scale: A Self-Report Depression Scale for Research in the General Population”. *Applied Psychological Measurement*, *1*(3), 385-401. URL: https://doi.org/10.1177/014662167700100306

Ruban et al. (Feb. 2021). “Quality of life in multiple sclerosis: The differential impact of motor and cognitive fatigue”. *Multiple Sclerosis Journal – Experimental, Translational and Clinical*, *7*(1), 2055217321996040. URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7907948/

Sleiman, S. F. et al. (Jun. 2016). “Exercise promotes the expression of brain derived neurotrophic factor (BDNF) through the action of the ketone body β-hydroxybutyrate”. *eLife*, *5*. URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4915811/

Socci, V. et al. (2017). “Enhancing human cognition with cocoa flavonoids”. *Frontiers in Nutrition*, *4*. URL: https://doi.org/10.3389/fnut.2017.00019

Tiftikçioğlu B. İ. (Sept. 2018). “Multiple Sclerosis Functional Composite (MSFC): Scoring Instructions”. *Arch Neuropsychiatry*, *55*(Suppl 1), S46-S48. URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6278631/pdf/archneuro-55-S46.pdf

Toricelli, M. et al. (Jan. 2021). “Mechanisms for neuroplasticity and brain degeneration: strategies for protection during the aging process”. *Neural Regeneration Research*, *16*(1). URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7818866/

Van der Linden, F. A. H. et al. (Jun. 2005). “Psychometric evaluation of the multiple sclerosis impact scale (MSIS-29) for proxy use”. *Journal of Neurology, Neurosurgery and Psychiatry, 76*, 1677-1681. URL: https://jnnp.bmj.com/content/jnnp/76/12/1677.full.pdf

Wadyka, S. & Seaver, M. (2024). “Train your brain”. In: *Real Simple.*

Wu, S. M. & Amtmann, D. (Dec. 2013). “Psychometric evaluation of the Perceived Stress Scale in multiple sclerosis”. *International Scholarly Research Notices, 2013.* URL: https://doi.org/10.1155/2013/608356

Yesavage, J. A., & Sheikh, J. I. (1986). “9/Geriatric Depression Scale (GDS): Recent Evidence and Development of a Shorter Version”. *Clinical Gerontologist*, *5*(1–2), 165–173. URL: https://doi.org/10.1300/J018v05n01_09

Zigmond, A. S. & Snaith, R. P. (Jun. 1983). “The Hospital Anxiety and Depression Scale”. *Acta Psychiatrica Scandinavica*, *67*(6), 361-370. URL: https://doi.org/10.1111/j.1600-0447.1983.tb09716.x

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