UNIVERSIDADE FEDERAL DE CIÊNCIAS DA SAÚDE DE PORTO ALEGRE

CURSO DE FISIOTERAPIA

Fernanda K Romio

Exploring the impact of desire-to-void and lower urinary tract symptoms (LUTS) on dual-task performance in aging women: a cross-sectional study

Porto Alegre

2023

Fernanda K Romio

Exploring the impact of desire-to-void and lower urinary tract symptoms (LUTS) on dual-task performance in aging women: a cross-sectional study

Trabalho de Conclusão de Curso de Fisioterapia, da Universidade Federal de Ciências da Saúde de Porto Alegre, como requisito parcial para obtenção do título de Bacharel em Fisioterapia

Orientador: Prof. Felipe de Souza Stigger
Coorientador: Daniela Aldabe

Porto Alegre
2023

Catalogação na Publicação

Romio, Fernanda
Exploring the impact of desire-to-void and lower urinary tract symptoms (LUTS) on dual-task performance in aging women: a cross-sectional study / Fernanda Romio. -- 2023.
38 p. : 30 cm.

Monografia (trabalho de conclusão de curso) -- Universidade Federal de Ciências da Saúde de Porto Alegre, Curso de Fisioterapia, 2023.

Orientador(a): Felipe de Souza Stigger ; coorientador(a): Daniela Aldabe.

1. Gait. 2. Dual-task. 3. Older Adults. 4. Urinary Incontinence. 5. Desire-to-void. I. Título.

Sistema de Geração de Ficha Catalográfica da UFCSPA com os dados fornecidos pelo(a) autor(a).

Dedico este trabalho aos pacientes que cruzaram meu caminho ao longo deste ano. Cada história compartilhada, cada desafio superado e cada vitória alcançada juntos moldaram a minha compreensão da essência da saúde e do cuidado.

AGRADECIMENTOS

A realização deste trabalho de conclusão de curso, a minha jornada acadêmica e a busca do título de fisioterapeuta, só foram possíveis graças ao apoio de diversas pessoas, as quais sou profundamente grata.

A enorme dedicação e vivência dos professores do Departamento de Fisioterapia da UFCSPA permitiram que eu pudesse estar finalizando esta grande etapa. Em especial, gostaria de agradecer ao meu orientador, professor Felipe de Souza Stigger, por seu acolhimento e por guiar tão bem os meus passos ao longo desse trabalho. Obrigada por compartilhar seu conhecimento, por acreditar em meu potencial e por ser um exemplo inspirador.

Expresso minha gratidão as participantes da pesquisa que generosamente contribuíram com o seu tempo para enriquecer esse estudo. Obrigada pela sua contribuição valiosa em prol da ciência.

Sou grata a minha família, minha base sólida e fonte inesgotável de amor. Agradeço aos meus pais, Aline e Felipe, pela oportunidade e incentivo de estudar num ensino público, gratuito e de qualidade. Vocês sempre acreditaram em mim, encorajando-me a persistir, superar desafios e nunca desistir dos meus sonhos. Espero algum dia conseguir retribuir com parte do que sempre me deram.

Ao meu irmão, Henrique, agradeço pela amizade e amor, por estar ao meu lado nos momentos mais felizes da minha vida, criando assim, memórias inesquecíveis. Te amo!

Ao meu noivo, Arthur, que acompanhou de perto essa jornada. Sua presença ao meu lado, o apoio incansável e as palavras de incentivo foram essências para minha motivação e para superar os obstáculos ao longo desta jornada. Você acreditou em mim quando duvidei de mim mesma e me lembrou repetidamente do meu potencial.

Ao meu fiel companheiro de quatro patas, Oliver, por sentar ao meu lado e parecer entender e acolher todo sentimento com sua presença amorosa.

Aos meus amados avós, Sérgio, Jurema e Irani, sou grata pelos seus ensinamentos de vida e pelo grande legado de amor. Vocês fazem parte desse

momento, meus grandes mestres! A estrela mais brilhante do céu, Vó Marlene, que sonhava com esse momento junto comigo e hoje me acompanha de outro lugar: você é a minha maior saudade.

Às belas amizades que a Fisioterapia uniu, minhas grandes amigas, que caminharam ao meu lado durante toda essa trajetória e se tornam meu novo “lar”, quero expressar minha sincera gratidão. Agradeço por todos os momentos compartilhados, pela amizade e pelo apoio mútuo. Vocês tornaram essa jornada mais leve e prazerosa, levarei para sempre comigo.

Agradeço aos meus amigos de longa data, em especial a Julia, com quem cultivei uma amizade forte, sincera e resistente a tempo.

Um agradecimento especial às fisioterapeutas e professoras Gabriela Tomedi Leites, Patrícia Viana da Rosa e Tatiane Gomes de Araújo, que enriqueceram o meu currículo com o conhecimento compartilhado. Obrigada por moldarem em mim o amor pela saúde da mulher. Almejo ser uma profissional impar como vocês. Obrigada!

Por fim, quero agradecer a todas as pessoas que de alguma forma me ajudaram, apoiaram, torceram e mandaram energia positiva! Sou muito sortuda e grata por estar rodeada de pessoas tão especiais na minha vida!

Muito obrigada!

RESUMO

Introdução: Mulheres idosas com incontinência urinária (IU) têm maior risco de cair do que mulheres idosas sem IU. A IU pode interferir na marcha cortical fornecendo distração atencional e aumentando o custo cognitivo (CC) durante a caminhada. **Objetivos**: O objetivo geral deste estudo é estabelecer se o desejo de urinar influencia o desempenho de tarefas funcionais em situações de dupla-tarefa. Os objetivos são: (1) avaliar a diferença no desempenho de dupla tarefa entre duas condições experimentais: sem desejo de urinar e com desejo de urinar; e (2) determinar se existe correlação entre os STUI e desempenho de dupla-tarefa durante a marcha em idosas. **Material e métodos**: Este estudo caracteriza se como um estudo observacional transversal. Mulheres acima de 60 anos foram convidadas a participar do presente estudo através de anúncios públicos na comunidade. As participantes foram solicitadas a realizar o teste "Timed up and go" (TUG) associado à duas tarefas secundárias: uma motora, o teste de Transferência de Moedas (TM), e uma cognitiva, o teste de Fluência Verbal Fonética (FVF). Ainda, essas condições foram realizadas em duas condições de desejo miccional: (1) nenhum desejo (bexiga vazia); e (2) desejo miccional (bexiga cheia). O grau de IU foi avaliado através do International Consultaion on Incontinence Questionnaire: Short Form (ICQIS- SF). Para comparar o custo cognitivo durante as diferentes condições experimentais, foi utilizada análise de variância de medidas repetidas (ANOVA). Para avaliar a correlação entre ICIQ e DTE foi utilizada a correlação de Kendall. **Resultados e conclusões**: Participaram deste estudo 42 mulheres (72.90 ± 5.81 anos) com graus variáveis de IU: nenhuma incontinência (n=13), incontinência leve (n=10), moderada (n=13) e grave (n=6). Nossos resultados confirmam que experimentar uma sensação de bexiga cheia ao caminhar impacta negativamente o desempenho da marcha em mulheres idosas. O desejo miccional durante a caminhada proporcionou um maior custo cognitivo quando comparado com condições de bexiga vazia ($p<0,01$). Não houve correlação significativa entre os dados apresentados pelo ICIQ e a performance do TUG em nenhuma das condições experimentais. Manter uma marcha consistente e estável e evitar quedas requer recursos cognitivos e processos de pensamento conscientes. Com tarefas adicionais, o desempenho funcional da marcha diminui, indicando um custo cognitivo da dupla tarefa (motora ou cognitiva) e um custo cognitivo adicional da sensação de bexiga cheia. Isso significa que lidar com a sensação de bexiga cheia pode ser uma fonte de desvio de atenção. Dessa forma pode concluir-se que o desejo miccional impacta negativamente o desempenho da caminhada em dupla tarefa em mulheres idosas indiferente do grau de IU.

Palavras-chave: Idosas, Desejo Miccional, Dupla Tarefa

ABSTRACT

Introduction: Elderly women with urinary incontinence (UI) have a higher risk of falling than elderly women without UI. UI may interfere with cortical gait by providing attentional distraction and increasing cognitive cost (CC) during walking. **Objectives:** The overall aim of this study is to determine whether the urge to urinate influences the performance of functional tasks in dual-task situations. The specific objectives are: (1) to assess the difference in dual-task performance between two experimental conditions: without the urge to urinate and with the urge to urinate; and (2) to establish whether there is a correlation between UI symptoms and dual-task performance during walking in elderly individuals. **Materials and Methods:** This study is characterized as a cross-sectional observational study. Women over the age of 60 were invited to participate in the current study through community public advertisements. The participants were asked to perform the "Timed up and go" (TUG) test associated with two secondary tasks: a motor task, the Coin Transfer Test (CTT), and a cognitive task, the Phonetic Verbal Fluency (PVF) test. Additionally, these conditions were conducted under two micturition desire conditions: (1) no desire (empty bladder); and (2) micturition desire (full bladder). The degree of UI was assessed using the International Consultation on Incontinence Questionnaire: Short Form (ICIQ-SF). To compare the cognitive cost during the different experimental conditions, repeated measures analysis of variance (ANOVA) was employed. Kendall's correlation was used to assess the correlation between ICIQ and DTE. R**esults and Conclusions:** Forty-two women (72.90 ± 5.81 years) with varying degrees of UI participated in this study: no incontinence (n=13), mild incontinence (n=10), moderate (n=13), and severe (n=6). Our results confirm that experiencing a full bladder sensation while walking negatively impacts the gait performance in elderly women. Micturition desire during walking incurred a higher cognitive cost compared to empty bladder conditions ($p<0.01$). There was no significant correlation between the data provided by the ICIQ and TUG performance in any of the experimental conditions. Maintaining a consistent and stable gait and preventing falls require cognitive resources and conscious thinking processes. With additional tasks, functional gait performance decreases, indicating a cognitive cost of dual-tasking (motor or cognitive) and an additional cognitive cost of the full bladder sensation. This suggests that dealing with the sensation of a full bladder can be a source of attentional distraction. Thus, it can be concluded that micturition desire negatively impacts dual-task gait performance in elderly women regardless of the degree of UI.

Keywords: Gait, Dual-task, Older Adults, Urinary Incontinence, Desire-to-void

LISTA DE FIGURAS

LISTA DE TABELAS

LISTA DE ABREVIATURAS E SIGLAS

LUTS Lower urinary tract symptoms

UI Urinary incontinence

ICIQ-SF International Consultation on Incontinence Questionnaire – Short Form

MoCA The Montreal Cognitive Assessment

ABC-16 Balance Confidence Scale

TUG Timed up-and-go

CTT Coin Transference test

PVF Verbal Fluency Test

USS Urinary sensation scale

DTE Dual-task effect

ANOVA Repeated measures analysis of variance

PFC Prefrontal cortex

SMA Supplementary motor area

DMN Default mode network

TUGb Timed up-and-go baseline

TUGme Timed up-and-go - motor dual-task empty bladder

TUGmf Timed up-and-go - motor dual-task full bladder

TUGce Timed up-and-go - cognitive dual-task empty bladder

TUGcf Timed up-and-go - cognitive dual-task full bladder

SUMÁRIO

REFERENCES

1. Irwin DE, Kopp ZS, Agatep B, Milsom I, Abrams P. Worldwide prevalence estimates of lower urinary tract symptoms, overactive bladder, urinary incontinence and bladder outlet obstruction. BJU Int. 2011;108(7):1132-1138. doi:10.1111/j.1464-410X.2010.09993.x
2. Irwin DE, Milsom I, Hunskaar S, et al. Population-Based Survey of Urinary Incontinence, Overactive Bladder, and Other Lower Urinary Tract Symptoms in Five Countries: Results of the EPIC Study. Eur Urol. 2006;50(6):1306-1315. doi:10.1016/j.eururo.2006.09.019
3. Simeonova Z, Milsom I, Kullendorff AM, Molander U, Bengtsson C. The prevalence of urinary incontinence and its influence on the quality of life in women from an urban Swedish population. Acta Obstet Gynecol Scand. 1999;78(6):546-551.
4. Coyne KS, Sexton CC, Thompson CL, et al. The prevalence of lower urinary tract symptoms (LUTS) in the USA, the UK and Sweden: results from the Epidemiology of LUTS (EpiLUTS) study. BJU Int. 2009;104(3):352-360. doi:10.1111/j.1464-410X.2009.08427.x
5. Chiarelli PE, Mackenzie LA, Osmotherly PG. Urinary incontinence is associated with an increase in falls: a systematic review. Australian Journal of Physiotherapy. 2009;55(2):89-95. doi:10.1016/S0004-9514(09)70038-8
6. Foley AL, Loharuka S, Barrett JA, et al. Association between the Geriatric Giants of urinary incontinence and falls in older people using data from the Leicestershire MRC Incontinence Study. Age Ageing. 2012;41(1):35-40. doi:10.1093/ageing/afr125
7. Gibson W, Hunter KF, Camicioli R, et al. The association between lower urinary tract symptoms and falls: Forming a theoretical model for a research agenda. Neurourol Urodyn. 2018;37(1):501-509. doi:10.1002/nau.23295
8. Biazus-Sehn LF, Baptista RR, Mestriner RG, Loss BP, Aldabe D, Stigger F de S. Influence of Different Dual-Task Conditions During Straight or Curved Walking on Gait Performance of Physically Active Older Women With Cognitive Decline. J Aging Phys Act. 2022;30(3):411-420. doi:10.1123/japa.2021-0099
9. Booth J, Paul L, Rafferty D, Macinnes C. The relationship between urinary bladder control and gait in women. Neurourol Urodyn. 2013;32(1):43-47. doi:10.1002/nau.22272
10. Lussier M, Renaud M, Chiva-Razavi S, Bherer L, Dumoulin C. Are stress and mixed urinary incontinence associated with impaired executive control in community-dwelling older women? J Clin Exp Neuropsychol. 2013;35(5):445-454. doi:10.1080/13803395.2013.789483
11. Yogev-Seligmann G, Hausdorff JM, Giladi N. The role of executive function and attention in gait. Mov Disord. 2008;23(3):329-342; quiz 472. doi:10.1002/mds.21720
12. Fraser SA, Elliott V, de Bruin ED, Bherer L, Dumoulin C. The Effects of Combining Videogame Dancing and Pelvic Floor Training to Improve Dual-Task Gait and Cognition in Women with Mixed-Urinary Incontinence. Games Health J. 2014;3(3):172-178. doi:10.1089/g4h.2013.0095
13. Chiarelli PE, Mackenzie LA, Osmotherly PG. Urinary incontinence is associated with an increase in falls: a systematic review. Australian Journal of Physiotherapy. 2009;55(2):89-95. doi:10.1016/S0004-9514(09)70038-8
14. Paquin MH, Duclos C, Lapierre N, et al. The effects of a strong desire to void on gait for incontinent and continent older community-dwelling women at risk of falls. Neurourol Urodyn. 2020;39(2):642-649. doi:10.1002/nau.24234
15. Lewis MS, Snyder PJ, Pietrzak RH, Darby D, Feldman RA, Maruff P. The effect of

acute increase in urge to void on cognitive function in healthy adults. Neurourol Urodyn. 2011;30(1):183-187. doi:10.1002/nau.20963
16. Klotzbier TJ, Korbus H, Johnen B, Schott N. Evaluation of the instrumented Timed Up and Go test as a tool to measure exercise intervention effects in nursing home residents: results from a PROCARE substudy. German Journal of Exercise and Sport Research. 2021;51(4):430-442. doi:10.1007/s12662-021-00764-0
17. Beauchet O, Fantino B, Allali G, Muir SW, Montero-Odasso M, Annweiler C. Timed up and go test and risk of falls in older adults: A systematic review. J Nutr Health Aging. 2011;15(10):933-938. doi:10.1007/s12603-011-0062-0
18. O'Shea S, Morris ME, Iansek R. Dual Task Interference During Gait in People With Parkinson Disease: Effects of Motor Versus Cognitive Secondary Tasks. Phys Ther. 2002;82(9):888-897. doi:10.1093/ptj/82.9.888
19. Chawla H, Walia S, Behari M, Noohu MM. Effect of type of secondary task on cued gait on people with idiopathic Parkinson′s disease. J Neurosci Rural Pract. 2014;5(01):18-23. doi:10.4103/0976-3147.127865
20. Opasso PR, Barreto S dos S, Ortiz KZ. Phonemic verbal fluency task in adults with high- level literacy. Einstein (São Paulo). 2016;14(3):398-402. doi:10.1590/S1679-45082016AO3629
21. Whiteside DM, Kealey T, Semla M, et al. Verbal Fluency: Language or Executive Function Measure? Appl Neuropsychol Adult. 2016;23(1):29-34. doi:10.1080/23279095.2015.1004574
22. Abwender DA, Swan JG, Bowerman JT, Connolly SW. Qualitative Analysis of Verbal Fluency Output: Review and Comparison of Several Scoring Methods. Assessment. 2001;8(3):323-338. doi:10.1177/107319110100800308
23. NIXON A, COLMAN S, SABOUNJIAN L, et al. A VALIDATED PATIENT REPORTED MEASURE OF URINARY URGENCY SEVERITY IN OVERACTIVE BLADDER FOR USE IN CLINICAL TRIALS. Journal of Urology. 2005;174(2):604-607. doi:10.1097/01.ju.0000165461.38088.7b
24. Coyne KS, Margolis MK, Hsieh R, Vats V, Chapple CR. Validation of the urinary sensation scale (USS). Neurourol Urodyn. 2011;30(3):360-365. doi:10.1002/nau.21005
25. Agmon M, Belza B, Nguyen HQ, Logsdon R, Kelly VE. A systematic review of interventions conducted in clinical or community settings to improve dual-task postural control in older adults. Clin Interv Aging. Published online March 2014:477. doi:10.2147/CIA.S54978
26. Plummer P, Eskes G. Measuring treatment effects on dual-task performance: a framework for research and clinical practice. Front Hum Neurosci. 2015;9. doi:10.3389/fnhum.2015.00225
27. Yogev‐Seligmann G, Hausdorff JM, Giladi N. The role of executive function and attention in gait. Movement Disorders. 2008;23(3):329-342. doi:10.1002/mds.21720
28. Clark DJ. Automaticity of walking: functional significance, mechanisms, measurement and rehabilitation strategies. Front Hum Neurosci. 2015;9. doi:10.3389/fnhum.2015.00246
29. Stöckel T, Mau-Moeller A. Cognitive control processes associated with successful gait performance in dual-task walking in healthy young adults. Psychol Res. 2020;84(6):1766-1776. doi:10.1007/s00426-019-01184-4
30. Timmermans C, Roerdink M, Janssen TWJ, Meskers CGM, Beek PJ. Dual-Task Walking in Challenging Environments in People with Stroke: Cognitive-Motor Interference

and Task Prioritization. Stroke Res Treat. 2018;2018:1-8. doi:10.1155/2018/7928597
31. Beauchet O, Dubost V, Aminian K, Gonthier R, Kressig RW. Dual-task-related gait changes in the elderly: does the type of cognitive task matter? J Mot Behav. 2005;37(4):259-264.
32. Hollman JH, Kovash FM, Kubik JJ, Linbo RA. Age-related differences in spatiotemporal markers of gait stability during dual task walking. Gait Posture. 2007;26(1):113-119. doi:10.1016/j.gaitpost.2006.08.005
33. Priest AW, Salamon KB, Hollman JH. Age-related differences in dual task walking: a cross sectional study. J Neuroeng Rehabil. 2008;5(1):29. doi:10.1186/1743-0003-5-29
34. Al-Yahya E, Dawes H, Smith L, Dennis A, Howells K, Cockburn J. Cognitive motor interference while walking: A systematic review and meta-analysis. Neurosci Biobehav Rev. 2011;35(3):715-728. doi:10.1016/j.neubiorev.2010.08.008
35. Montero-Odasso M, Muir SW, Speechley M. Dual-Task Complexity Affects Gait in People With Mild Cognitive Impairment: The Interplay Between Gait Variability, Dual Tasking, and Risk of Falls. Arch Phys Med Rehabil. 2012;93(2):293-299. doi:10.1016/j.apmr.2011.08.026
36. Smith E, Cusack T, Blake C. The effect of a dual task on gait speed in community dwelling older adults: A systematic review and meta-analysis. Gait Posture. 2016;44:250-258. doi:10.1016/j.gaitpost.2015.12.017
37. Paquin M, Duclos C, Lapierre N, et al. The effects of a strong desire to void on gait for incontinent and continent older community‐dwelling women at risk of falls. Neurourol Urodyn. 2020;39(2):642-649. doi:10.1002/nau.24234
38. Gibson W, Jones A, Hunter K, Wagg A. Urinary urgency acts as a source of divided attention leading to changes in gait in older adults with overactive bladder. PLoS One. 2021;16(10):e0257506. doi:10.1371/journal.pone.0257506
39. Pang D, Gao Y, Liao L, Ying X. Brain functional network alterations caused by a strong desire to void in healthy adults: a graph theory analysis study. Neurourol Urodyn. 2020;39(7):1966-1976. doi:10.1002/nau.24445
40. Pashler H. Dual-task interference in simple tasks: data and theory. Psychol Bull. 1994;116(2):220-244. doi:10.1037/0033-2909.116.2.220
41. Ruthruff E, Pashler HE, Klaassen A. Processing bottlenecks in dual-task performance: Structural limitation or strategic postponement? Psychon Bull Rev. 2001;8(1):73-80. doi:10.3758/BF03196141
42. Tombu M, Jolicœur P. A central capacity sharing model of dual-task performance. J Exp Psychol Hum Percept Perform. 2003;29(1):3-18. doi:10.1037/0096-1523.29.1.3
43. Basil MD. Multiple Resource Theory. In: Encyclopedia of the Sciences of Learning. Springer US; 2012:2384-2385. doi:10.1007/978-1-4419-1428-6_25
44. Wickens CD. Multiple resources and performance prediction. Theor Issues Ergon Sci. 2002;3(2):159-177. doi:10.1080/14639220210123806
45. Zhao L, Liao L, Gao Y. Brain functional connectivity during storage based on resting state functional magnetic resonance imaging with synchronous urodynamic testing in healthy volunteers. Brain Imaging Behav. 2021;15(3):1676-1684. doi:10.1007/s11682-020-00362-y
46. Gao Y, Liao L, Blok BFM. A resting-state functional MRI study on central control of storage: brain response provoked by strong desire to void. Int Urol Nephrol. 2015;47(6):927-935. doi:10.1007/s11255-015-0978-0

47. Lu CF, Liu YC, Yang YR, Wu YT, Wang RY. Maintaining Gait Performance by Cortical Activation during Dual-Task Interference: A Functional Near-Infrared Spectroscopy Study. PLoS One. 2015;10(6):e0129390. doi:10.1371/journal.pone.0129390
48. Doi T, Makizako H, Shimada H, et al. Brain activation during dual-task walking and executive function among older adults with mild cognitive impairment: a fNIRS study. Aging Clin Exp Res. 2013;25(5):539-544. doi:10.1007/s40520-013-0119-5
49. Friedman NP, Robbins TW. The role of prefrontal cortex in cognitive control and executive function. Neuropsychopharmacology. 2022;47(1):72-89. doi:10.1038/s41386-021-01132-0
50. Tachibana A, Noah J, Bronner S, et al. Activation of dorsolateral prefrontal cortex in a dual neuropsychological screening test: An fMRI approach. Behavioral and Brain Functions. 2012;8(1):26. doi:10.1186/1744-9081-8-26
51. Guo Y, Liu P, Huang X. The Practice Effect on Time-Based Prospective Memory: The Influences of Ongoing Task Difficulty and Delay. Front Psychol. 2019;10. doi:10.3389/fpsyg.2019.02002
52. Lee BC, Choi J, Martin BJ. Roles of the prefrontal cortex in learning to time the onset of pre-existing motor programs. PLoS One. 2020;15(11):e0241562. doi:10.1371/journal.pone.0241562
53. Duffau H. Cortical and Subcortical Brain Mapping. In: Schmidek and Sweet Operative Neurosurgical Techniques. Elsevier; 2012:80-93. doi:10.1016/B978-1-4160-6839-6.10006-1
54. Johansen-Berg H, P. M. Attention to movement modulates activity in sensori-motor areas, including primary motor cortex. Exp Brain Res. 2002;142(1):13-24. doi:10.1007/s00221-001-0905-8
55. Pang D, Gao Y, Liao L, Ying X. Brain functional network alterations caused by a strong desire to void in healthy adults: a graph theory analysis study. Neurourol Urodyn. 2020;39(7):1966-1976. doi:10.1002/nau.24445
56. Crockett RA, Hsu CL, Best JR, Liu-Ambrose T. Resting State Default Mode Network Connectivity, Dual Task Performance, Gait Speed, and Postural Sway in Older Adults with Mild Cognitive Impairment. Front Aging Neurosci. 2017;9. doi:10.3389/fnagi.2017.00423
57. Bohannon RW. Reference Values for the Timed Up and Go Test. Journal of Geriatric Physical Therapy. 2006;29(2):64-68. doi:10.1519/00139143-200608000-00004
58. Moon S, Chung HS, Kim YJ, et al. The impact of urinary incontinence on falls: A systematic review and meta-analysis. PLoS One. 2021;16(5):e0251711. doi:10.1371/journal.pone.0251711
59. O'Connell KA, Nicholas TB, Palmer MH. Toileting behaviors, urinary cues, overactive bladder, and urinary incontinence in older women. Int Urogynecol J. 2023;34(3):707-716. doi:10.1007/s00192-022-05228-z
60. Steenstrup B, Le Rumeur E, Moreau S, Cornu JN. Sédentarité et incontinence urinaire chez la femme : une revue de littérature. Progrès en Urologie. 2018;28(17):973-979. doi:10.1016/j.purol.2018.07.006
61. Dowd TT, Campbell JM, Jones JA. Fluid Intake and Urinary Incontinence in Older Community-Dwelling Women. J Community Health Nurs. 1996;13(3):179-186. doi:10.1207/s15327655jchn1303_5
62. Adan A. Cognitive Performance and Dehydration. J Am Coll Nutr. 2012;31(2):71-78. doi:10.1080/07315724.2012.10720011

63. Summary for Policymakers. In: Climate Change 2013 – The Physical Science Basis. Cambridge University Press; 2014:1-30. doi:10.1017/CBO9781107415324.004
64. Benton D, Jenkins KT, Watkins HT, Young HA. Minor degree of hypohydration adversely influences cognition: a mediator analysis. Am J Clin Nutr. 2016;104(3):603-612. doi:10.3945/ajcn.116.132605
65. Pross N. Effects of Dehydration on Brain Functioning: A Life-Span Perspective. Ann Nutr Metab. 2017;70(Suppl. 1):30-36. doi:10.1159/000463060
66. Nakao T, Nakagawa A, Yoshiura T, et al. Brain activation of patients with obsessive-compulsive disorder during neuropsychological and symptom provocation tasks before and after symptom improvement: A functional magnetic resonance imaging study. Biol Psychiatry. 2005;57(8):901-910. doi:10.1016/j.biopsych.2004.12.039
67. BOHANNON RW. Comfortable and maximum walking speed of adults aged 20—79 years: reference values and determinants. Age Ageing. 1997;26(1):15-19. doi:10.1093/ageing/26.1.15
68. Deshpande N, Metter EJ, Bandinelli S, Guralnik J, Ferrucci L. Gait speed under varied challenges and cognitive decline in older persons: a prospective study. Age Ageing. 2009;38(5):509-514. doi:10.1093/ageing/afp093
69. Shkuratova N, Morris ME, Huxham F. Effects of age on balance control during walking. Arch Phys Med Rehabil. 2004;85(4):582-588. doi:10.1016/j.apmr.2003.06.021
70. Beauchet O, Dubost V, Herrmann F, Rabilloud M, Gonthier R, Kressig RW. Relationship between dual-task related gait changes and intrinsic risk factors for falls among transitional older adults. Aging Clin Exp Res. 2005;17(4):270-275. doi:10.1007/BF03324609
71. Leone C, Feys P, Moumdjian L, D'Amico E, Zappia M, Patti F. Cognitive-motor dual-task interference: A systematic review of neural correlates. Neurosci Biobehav Rev. 2017;75:348- 360. doi:10.1016/j.neubiorev.2017.01.010
72. Siu KC, Chou LS, Mayr U, van Donkelaar P, Woollacott MH. Attentional mechanisms contributing to balance constraints during gait: The effects of balance impairments. Brain Res. 2009;1248:59-67. doi:10.1016/j.brainres.2008.10.078
73. Gibson W, Jones A, Hunter K, Wagg A. Urinary urgency acts as a source of divided attention leading to changes in gait in older adults with overactive bladder. PLoS One. 2021;16(10):e0257506. doi:10.1371/journal.pone.0257506
74. Clarkson BD, Wei Z, Karim HT, et al. Neuroimaging of situational urgency and incontinence provoked by personal urgency cues. Neurourol Urodyn. 2022;41(1):166-173. doi:10.1002/nau.24800
75. Dovan ML. Examining the Effects of Anxiety on Running Efficiency in a Cognitive-motor Dual-task. Masters thesis, Concordia University. Published online 2013.
76. Klingberg T. Limitations in information processing in the human brain: neuroimaging of dualtask performance and working memory tasks. In: ; 2000:95-102. doi:10.1016/S0079-6123(00)26009-3
77. Paquin M, Duclos C, Lapierre N, et al. The effects of a strong desire to void on gait for incontinent and continent older community‐dwelling women at risk of falls. Neurourol Urodyn. 2020;39(2):642-649. doi:10.1002/nau.24234