

Aging Research Symposium Poster Abstract Booklet

2nd Annual

Co-Sponsored by:

Claude D. Pepper Older Americans
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UNIVERSITY of MARYLAND
SCHOOL OF MEDICINE
CENTER FOR RESEARCH ON AGING

2nd Annual Aging Research Symposium Poster Abstract Booklet

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Forward

The University of Maryland School of Medicine Center for Research on Aging is proud to present poster abstracts from the 2nd Annual Aging Research Symposium that was to be held on April 24th, 2020. Due to COVID-19 restrictions we were unable to host Dr. Linda Fried, Dean of the Mailman School of Public Health of Columbia University Medical Center, presenting “Pillars of Health in Longevity” as the guest speaker, as well as the poster session featuring aging related research by faculty, fellows and graduate students. This compilation of abstracts from faculty, fellows and graduate students from UMB, UMBC, and the University of Maryland College Park presents some of the exciting research in aging on our campuses.

The mission of the Center for Research on Aging is to facilitate, amplify, and enrich research in gerontology and geriatrics; provide outstanding research training and educational opportunities in gerontology for graduate students and health professionals; and enhance delivery of excellent multidisciplinary geriatric care that prevents functional and mental disability in the elderly, and promotes a healthy lifestyle. We currently have 150 affiliates that focus on aging research, education, and clinical care. We are hoping that these abstracts will inspire others and promote collaborations amongst students, fellows, and faculty at our campuses and beyond. Through these collaborations, faculty continue to secure aging-related grants, establish new research collaborations, and strengthen already established areas of research.

The Center for Research on Aging would like to thank Dean Reece for his ongoing support of aging research as well as the many Centers across campus that focus on the aging population and improving their health and quality of life.

We hope to see you later in 2020 when we hope to reschedule Dr. Fried’s presentation and in spring 2021 for our 3rd annual Aging Symposium to continue to promote aging research at the University of Maryland.

Sincerely,



Jay Magaziner, PhD, MS Hyg
Professor and Chair
Department of Epidemiology and Public Health
Director, Center for Research on Aging
University of Maryland School of Medicine

Aging Symposium Planning Committee:

Barbara Resnick, PhD, CRNP
Nicole Brandt, PharmD, MBA, BCPP, CGP, FASCP
Steven Gambert, MD, MACP
Joel Greenspan, PhD
Diane Martin, PhD
Justine Golden, MA
Anne Sullens, MS

The Geriatrics & Gerontology Education and Research Professional Award

The award is given to an outstanding graduating professional student selected by the School/Division based upon the student's demonstrated commitment to the field of geriatric/gerontological studies. The nominating faculty prepare ~1-page summary of the student's commitment as evidenced by contributions in one or more of five areas of accomplishments:

- a. Innovations in direct practice with older persons;
- b. Scholarly work which has implications for improving clinical practice with older persons;
- c. Leadership in developing or sustaining geriatrics/gerontological educational programs for students, other practitioners and/or consumers;
- d. Positive impact on health care, social or legal policies and/or legislation relating to older persons;
- e. Interprofessional experience in a geriatrics setting.

Nominations are due in April each year. Students are recognized during a ceremony later that month. The award is \$100 and a certificate of recognition.

2020 Recipients

Alyssa J. Nelson, School of Dentistry, Division of Dental Hygiene

Letter of Nomination: Sheryl Syme, RDH, MS

Summary of nomination letter: Alyssa was unanimously selected for the GGEAR award because of the caring and individualized approach she takes in addressing the dental hygiene needs of her older adult patients. She is described as having both an interest in older adults and natural abilities in communicating with them in a way that allows her to easily gain her patient's confidence and demonstrate her genuine interest in their lives. This was exemplified during her first semester of clinic-patient care experiences when she made a Valentine's Day gift bag, in which she included items such as pocket tissues, hand sanitizer, toothbrush, and large size tube of toothpaste, for one of her older male patients with financial limitations. Alyssa's faculty and peers were described as being "in awe" of her ingenuity and thoughtfulness in treating her patient so specially and thinking of him during a holiday when so many widowers are often forgotten and excluded. At the time, Alyssa's peers commented that "She is always so thoughtful with her geriatric patients, "That is just like Alyssa...", and "I am not surprised, she treats her patients like gold." Her exceptional chairside manner is characterized as treating older adult patients with the utmost respect and attentiveness to their individual needs. Professor Syme wrote that Alyssa will "go the extra mile in focusing on each patient's unique characteristics while respecting the lifetime of wisdom and experience that makes each geriatric patient special. The connections that Alyssa makes with her older adult patients are much admired among her peers and unanimously noted by the dental hygiene faculty who work with her in other clinics in the School of Dentistry."

Jennifer Woodard, School of Medicine, Division of Gerontology and Geriatric Medicine

Letter of Nomination: Jacob Blumenthal, MD, FACP; Steven Gambert, MD, AGSF, MACP

Summary of nomination letter: Jennifer is described as "having it all" and eminently qualified for the GGEAR award because of her long history of commitment to the field and care of older persons. While earning both a BS in Biochemistry and Chemical Biology as well as a BA in Spanish, graduating magna cum laude with honors, Phi Beta Kappa, she also found time to volunteer, mentor, and research at the CDC and NIH. After coming to Baltimore, her remarkable trajectory continued. She was significantly involved in a number of research projects and active in the local chapter of the American College of Physicians. A steadfast proponent of Geriatrics on this campus, Jennifer served as President of the *Geriatrics Interest Group* for two years, and was very active in related activities, including interprofessional programs. This summer, Jennifer will be pursuing

residency/fellowship training in Geriatrics in a combined training program in Internal Medicine and Geriatrics at the Medical College of Wisconsin.

Amber Wincek, School of Medicine, Department of Physical Therapy and Rehabilitation Science

Letter of Nomination: Vincent Conroy, PT, DScPT

Summary of nomination letter: Amber was unanimously nominated by her peers and faculty, and her final selection as the awardee based upon her body of work in which she has met 4 of the 5 criteria established for the GGEAR award. Amber's research and innovative approaches to patient care will easily lend themselves to her desired career goal of working with older adult skilled nursing center patients. She plans to use knowledge gleaned from her case report entitled, "A Case Report: The Effect of Physical Therapy Intervention Including Manual Therapy, Strengthening and Neurological Re-education on Adults with Shoulder Pain" to help patients with similar diagnoses in the geriatric population. Similarly, through her in-service rotations, which included a 75% older adult caseload, she gained an understanding of techniques that physical therapists can use to improve pulmonary health for patients across the lifespan. Amber's interprofessional experience includes volunteer with older adults, including leading a session for the program "Stepping On" which is an evidence-based falls prevention program for adults over 60-years-old and creating and prescribing a group exercise class called "Silver Fitness" for a group of patients at a local senior living facility to improve activity participation. Additionally, as part of her clinical rotations, Amber volunteered at a senior community center to perform diabetic foot screens with her classmates and also spent time educating seniors on preventing falls. Amber states that "[a]ll of these experiences have shaped me into the person I am today, which I am proud to say is a soon to be graduate of University of Maryland, Baltimore's Doctor of Physical Therapy program pursuing a career at a skilled nursing facility on the West Coast. I am eager to begin my journey to help those stay healthy, safe, and happy as they enjoy the best years of their lives."

Claire Regan, School of Nursing, Adult Gerontology Primary Care Nurse Practitioner Program

Letter of Nomination: Elizabeth Galik, PhD, CRNP, FAAN, FAANP; Barbara Resnick, PhD, CRPN, FAAN, FAANP

Summary of nomination letter: Described as an excellent student who is deeply committed to a career in caring for older adults in long term care settings, Claire came to UMB with an interest in geriatrics. Throughout both her professional and academic career, Claire has worked diligently to address geriatric syndromes and implement non-pharmacological interventions to improve cognitive stimulation with nursing home residents with dementia and reduce the inappropriate use of psychotropic medications. Claire has remained dedicated to her patients as an RN in long-term care while simultaneously pursuing her DNP. She is described as someone who has always taken her studies and clinical rotations very seriously; actively seeking out new learning opportunities, especially when it involves geriatrics. Her diagnostic skills and treatment planning takes into account the unique presentations and needs of older adults, particularly those residents with cognitive impairment. Her faculty, clinical preceptors, and peers speak highly of her clinical performance and dedication to the treatment of residents in long term care. In addition to seeking out clinical experiences at a variety long term care facilities, she completed her program with a project that focused on cognitive stimulation for nursing home residents with dementia and presented these findings at the annual meeting of AMDA, the Society for Post-Acute and Long Term Care Medicine. Claire's faculty noted that her knowledge of older adults and superior clinical skills will make her a valuable nurse practitioner upon her graduation and they "only expect great things in her future and are certain that she will remain committed to the care of older adults within long term care settings."

Jennifer Miller, School of Pharmacy, The Peter Lamy Center on Drug Therapy and Aging
Letter of Nomination: Nicole Brandt, PharmD, MBA, BCGP, BCPP, FASCP; The Lamy Center Team

Summary of nomination letter: Jennifer's commitment to geriatrics and gerontology has been evident throughout her academic career. Focused on the value of interprofessional collaboration, she has been deeply involved in promoting collaborative work, both on and off campus. Her scholarly work has implications for improving clinical practice with older persons. For example, in November 2019, Jennifer developed and co-led an educational lecture for the School of Dentistry on the topic of interprofessional collaboration between dentists and pharmacists to address the opioid crisis. She has been involved with the research committee of the University of Maryland Health Alliance (UMBHA), where she was instrumental on creating and leading presentations focused on medication safety in older adults. Jennifer's leadership was also evidenced in her desire and ability to develop/sustain educational programs for students, other practitioners and/or consumers. For example, she started a vibrant exercise program during the IPE Care in Geriatrics course and would rally the students and neighbors for weekly exercises appropriate for older adults as part of a fall prevention program. Her commitment to interprofessional geriatric experiences as her education included participating in elective coursework in which she observed first-hand the disparities in social determinants of health that older adults face every day while they lived at home, such as difficulty to place a phone call, read a medication vial label, adhere to their treatment regimens or access services. Throughout the course, Jennifer's demeanor was exemplary; she exhibited excellent interpersonal skills and carried herself in a way that drew the admiration and respect of all of her colleagues and faculty. Jennifer has also made a positive impact in her appointed position as the Policy and Advocacy Legislative Day Team Leader from February 2017 to February 2019. She was responsible for coordinating talking points among pharmacy students from various Maryland schools. Additionally, she spent the day with many pharmacists as well as students in Washington DC advocating on drug cost transparency as well as clinical services to optimize medication safety in older adults. After graduation, Jennifer will embark upon her residency training at the Washington DC Veterans Affairs hospital. Her nominators are confident that her experiences at UMB coupled with her substantial level of maturity, passion, and understanding will make her a valuable team member as she cares for older veterans.

Kaitlynn Ecker, School of Social Work

Letter of Nomination: Joan Davitt, PhD, MSS, MLSP

Summary of nomination letter: Kaitlynn has demonstrated a strong commitment to addressing the needs of the most vulnerable older adults, particularly those who are frail and at risk of intimate partner or elder abuse. She has excelled in the classroom, in her field placements, and as a research assistant. For example, Kaitlynn submitted the best policy brief in Dr. Davitt's Aging and Social Policy course this spring, even while handling the added stress and anxiety related to the novel corona virus. Kaitlynn has distinguished herself in practice as well, working with the most vulnerable older adults in adult protective services settings and with very frail older adults being served by the PACE program. Based on her tremendous dedication to making the world a better place for vulnerable older adults, Dr. Davitt writes that she is confident that Kaitlynn will make a "positive impact on the lives of the vulnerable older adults she encounters in her career, and will advocate to enhance the equitability of care systems in Maryland and beyond."

Bio-Medical/Basic Poster Abstracts

Age-related Smell and Taste Impairments and Serum 25-hydroxyvitamin D Associations in the U.S. Adults. National Health and Nutrition Examination Survey

*Galya Bigman, PhD*¹

¹ Division of Epidemiology and Prevention, Institute of Human Virology, University of Maryland School of Medicine, Baltimore, MD 21201; gbigman@ihv.umaryland.edu

Abstract: Smell and taste decline with aging, and markedly deteriorate when nutritional deficiencies occur. This study aims to examine the association between Vitamin D deficiency and smell and taste impairments among adults. A cross-sectional study utilizing data from the U.S. National Health and Nutrition Examination Survey (2013–2014.). Smell impairment was assessed by the Pocket Smell Test and defined as failing to correctly identify 6 or more of the 8 odors. Taste impairment was defined as failing to correctly identify quinine or sodium chloride. Vitamin D was measured as serum 25-hydroxyvitamin D(25(OH)D). Weighted logistic regression models were utilized to examine study aims. Overall, 2,216 (smell sample) and 2,636(taste sample) participants were included with age ranged between 40-80 years. Of those, 18.7% had taste impairment, 12.2% smell impairment, and 25% had serum 25(OH)D deficiency (<20ng/ml). The study showed that participants with serum 25(OH)D deficiency were more likely by 39% to report a higher prevalence of smell impairment (OR=1.39,95%CI:1.02-1.89) after adjustment for confounders. Vitamin D deficiency may have a significant role in smell impairment among adults. Therefore, smell assessments could be used as a screening test in detecting people with Vitamin D deficiency, and age-related smell impairment can be mitigated with Vitamin D treatment.

Work in Progress

Bio-Medical/Basic

Age-associated *S. Typhi* Specific Tissue Resident Memory T Cell Responses in the Terminal Ileum Mucosa of Elderly Volunteers Following Oral Ty21a Immunization

Jayaum S. Booth, MS, PhD, Eric Goldberg, MD, Seema Patil, MD, Robin Barnes, CRNP, Bruce D. Greenwald, MD, and Marcelo B. Sztein, MD

The impact of aging on the immune system is unambiguous and mainly attributed to the age-associated decline in immunity process termed immunosenescence. While it is important to understand the mechanisms of immunosenescence, most studies have examined this process in human peripheral blood. However, the majority of immune cells are present in tissue compartments and exhibit differential cell subset (e.g., memory T cells) distribution than peripheral blood. Thus, it is crucial to understand immunosenescence in tissues, especially those that are exposed to pathogens (e.g. intestine). Tissue resident memory T (T_{RM}) provide immediate adaptive effector immune responsiveness at the infection site. However, it is unknown whether *S. Typhi* infection or oral live attenuated typhoid vaccine Ty21a induces T_{RM} of elderly volunteers in a similar manner as in adults at the site of infection (Terminal ileum; TI). Using the Ty21a vaccine, we determined the effect of aging on the elicitation of vaccine induced T_{RM} cells in the TI mucosa. Here, we compare the induction of *S. Typhi*-specific T_{RM} subsets elicited by Ty21a in the TI lamina propria between elderly and adult volunteers. Interestingly, aging seems to influence the frequencies of TI-lamina propria mononuclear cells (LPMC) memory T (T_M) and T_{RM} in both Ty21a-vaccinated, as well as in the control group (**Fig. 1A-B**). In addition, we noted that the frequencies of LPMC T_{RM} correlated with the age of the volunteers following Ty21a immunization. For example, in unvaccinated volunteers, we observed that LPMC CD103-CD4+ T_{RM} displayed a strong ($p<0.05$) positive correlation with age, while CD103+ CD4+ T_{RM} displayed moderate ($p=0.06$) negative correlation with age of the volunteers (**Fig. 2**). Regarding antigen-specific responses, we observed that elderly volunteers have poorer mucosal immune responses following Ty21a immunization. For e.g. CD103+ CD4+ T_{RM} showed a decreasing trend of IL-17A in elderly than in adult volunteers following Ty21a immunization. Similarly, we observed that CD103- CD4+ T_{RM} displayed significantly ($p<0.05$) lower levels of IL-17A and IL-2 in elderly than in adult volunteers following Ty21a immunization (**Fig. 3**). *S. Typhi* responsive CD8+ T_{RM} and CD103-CD8+ T cells were also different between elderly and adult volunteers following Ty21a immunization. CD8+ T_{RM} showed a trend to show lower IL-17A responses in the elderly than in adult volunteers following Ty21a immunization. In contrast, we observed that CD103- CD8+ T cells displayed significantly ($p<0.05$) lower levels of IL-17A and increasing trend in IL-2 in elderly than adult volunteers following Ty21a immunization (**Fig. 4**). Finally, we determined and compared the multifunctional (MF) profiles of both CD4+ and CD8+ T_{RM} subsets between elderly and adult volunteers and showed significant differences in the quality and quantity of the elicited single (S) and MF responses. In summary, the aging process influence tissue resident T memory *S. Typhi*-specific responses in the terminal ileum following oral Ty21a-immunization. This study is the first to report novel insights in the generation of local vaccine-specific responses in the terminal ileum of elderly individuals. In addition, this report highlights the importance of evaluating tissue immune responses in the context of infection and aging.

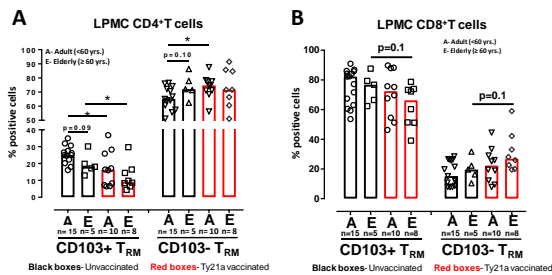


Fig. 1: Age-associated differences in the frequencies of T_{RM} cells isolated from Ty21a-vaccinated and unvaccinated volunteers. Frequencies of (A) TI-LPMC CD4+CD103+ and CD4+CD103- T_{RM} and (B) TI-LPMC CD8+CD69+CD103+ (CD8+ T_{RM}) and CD8+CD69+CD103- T cells obtained from Ty21a-vaccinated (red symbols) and unvaccinated (black symbols) volunteers were determined and compared between adults (A- < 60 yrs.) and elderly (E- \geq 60 yrs.) volunteers. Median values for each group are denoted as horizontal black bars. Significant differences are denoted with * P <0.05. Trends to exhibit significance values are indicated by their p-values.

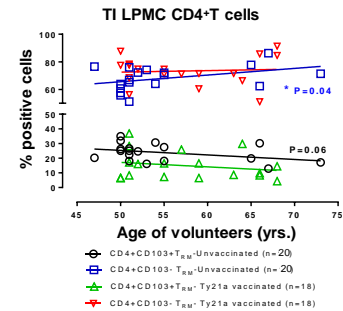


Fig. 2: Age-dependent association of TI CD4+ T_{RM} subsets frequencies following oral Ty21a immunization. Correlations between age and the frequencies of tissue resident CD4+ T cells were determined using Pearson's analysis. (A) Unvaccinated LPMC CD4+CD103+ T_{RM} (black symbols), and CD4+CD103- T_{RM} (blue symbols), as well as Ty21a-vaccinated LPMC CD4+CD103+ T_{RM} (green symbols) and CD4+CD103- T_{RM} (red symbols) frequencies were correlated to the age of the volunteers. Significant correlations are denoted with * P <0.05. Trends to exhibit significance correlations values are indicated by their p-values.

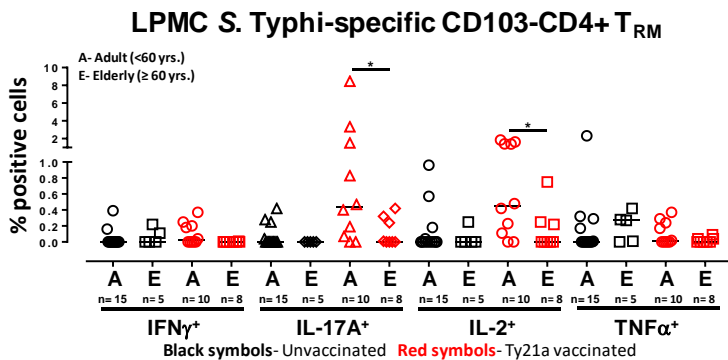


Fig. 3: S. Typhi-specific responses of TI LPMC CD69+CD103-CD4+ T_{RM} subsets in healthy adults and elderly volunteers following oral Ty21a-immunization. The net percentages of S. Typhi-specific responses (IFN- γ , IL-17A, IL-2, and TNF- α) in CD69+CD103- CD4+ T_{RM} subsets were compared between adults (A-<60 yrs.) and elderly (E- \geq 60 yrs.) volunteers that were either Ty21a-vaccinated (red symbols) or unvaccinated (black symbols) with significant differences (* P < 0.05) indicated. Horizontal bars (black) represent median values.

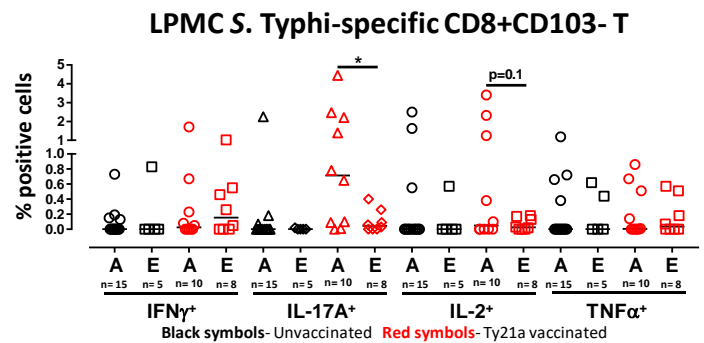


Fig. 4: S. Typhi-specific responses of TI LPMC CD69+CD103-CD8+ T_{RM} subsets in healthy adults and elderly volunteers following oral Ty21a-immunization. The net percentages of S. Typhi-specific responses (IFN- γ , IL-17A, IL-2, and TNF- α) in CD69+CD103- CD8+ T_{RM} subsets were compared between adults (A-<60 yrs.) and elderly (E- \geq 60 yrs.) volunteers that were either Ty21a-vaccinated (red symbols) or unvaccinated (black symbols) with significant differences (* P < 0.05) indicated. Trends to exhibit significance are indicated by their p-values. Horizontal bars (black) represent median values.

Work in Progress

Bio-Medical/Basic

Hippocampal Plasticity After Acute Exercise in Older Adults: A Diffusion Tensor Imaging Study

Callow, D.D.^{1,2}, Won, J.¹, Alfini, A.J.³, Weiss, L.R.^{1,2}, Purcell, J.J.¹, Zhan, W.^{1,2}, Smith, J.C.^{1,2}

¹Department of Kinesiology, School of Public Health, University of Maryland, College Park, MD

²Program in Neuroscience and Cognitive Science, University of Maryland, College Park, MD

³Department of Mental Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

Objective: The hippocampal formation is essential for many cognitive and memory processes, but also shows structural and functional decline with age. Exercise is known to benefit the aging brain and protects hippocampal volume, activation, and memory-related cognitive processes. To date, most studies have focused on the effects of exercise on long-term volumetric changes in the hippocampus using structural MRI. However, there may be neuroplastic changes in the hippocampus in response to a single session of exercise at a micro-scale that may not alter the volume yet are functionally relevant. To examine this, we used Diffusion Tensor Imaging (DTI) to measure short-term microstructural alterations within the hippocampus.

Participants and Methods: We used a within subject-design to determine how a 30-minute bout of moderate-intensity aerobic exercise altered bilateral hippocampal DTI measures in healthy older adults ($n=30$, age=66.4 (± 7.5)) compared to a seated rest control condition. Anatomical regions of interest (ROI) were extracted using Freesurfer (6.0) [1]. Diffusion-weighted images were processed using tools in the FMRIB Software Library (FSL v6.0.1) [2]). Using the FMRIB Diffusion Toolbox, subject motion, eddy current-induced distortions, and b_0 inhomogeneities were corrected [3], [4]. Anatomical ROI were linearly warped into native diffusion space using Freesurfer's `bbregister` function. **Figure 1** displays an example of a single participant's hippocampal segmentation, registration to diffusion space, and extraction of hippocampal FA measures.

Results: We observed significantly reduced fractional anisotropy ($Z=3.16$, p -value=0.002) and increased radial diffusivity ($Z=2.20$, p -value=0.028) within the hippocampus following the exercise condition. There were no significant differences in mean diffusivity ($Z=1.56$, p -value=0.11) or axial diffusivity ($Z = .589$, $p = 0.556$) were significantly higher than after rest (see **Figure 2**). We also assessed differences in diffusivity measures between the exercise and rest conditions for two control regions in the amygdala and middle temporal cortex to rule out the general effects of exercise on diffusion. There were no significant differences in FA ($Z=.304$, p -value = .761; $Z=.588$, $p=.556$) or MD ($Z=.243$, p -value=.808; $Z=-1.06$, $p=.289$) between conditions, respectively).

Conclusions: These findings suggest a single session of exercise can lead to microstructural changes in the hippocampus of healthy older adults. These differences may be associated with changes in the extracellular space, glial, or dendritic processes within the hippocampus. These findings suggest repeated microstructural alterations from acute bouts of exercise may accumulate and precede more substantial volumetric and functional improvements in the hippocampus.

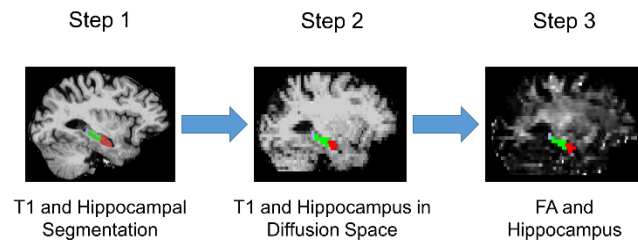


Figure 1 Example of a single participant's hippocampal segmentation and extraction process, including the hippocampal tail (blue), body (green), and head (red). First, the T1-weighted images were segmented (Step 1); then, the T1-weighted segmentation was aligned with the diffusion-weighted image (Step 2), and finally, the diffusivity metrics were aligned with the hippocampal mask in the participant's native space (Step 3). Full hippocampal ROIs were created by combining tail, body, and head segmentations. Posterior hippocampal ROIs were created by combining the tail and body segmentations while the head segmentation was used to create the anterior hippocampal ROI. T1 = T1-weighted anatomical scan. FA = fractional anisotropy image.

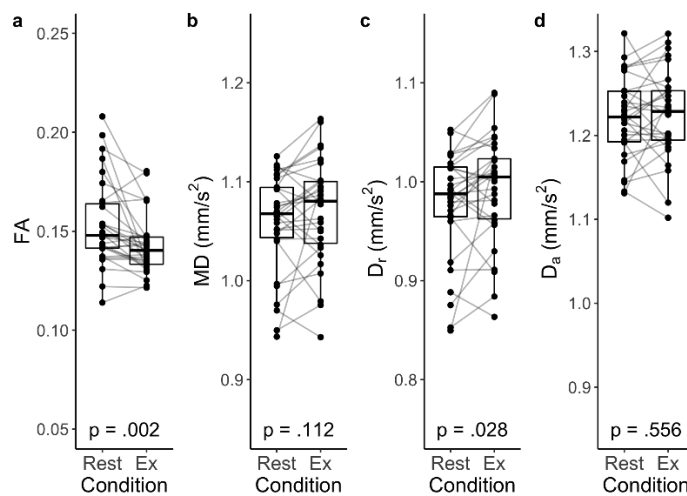


Figure 2 Results of a Wilcoxon signed-rank test comparing bilateral hippocampal diffusivity following 30 minutes of aerobic exercise (Ex) versus after a seated rest cond. a) Fractional anisotropy (FA) was significantly lower following exercise compared to seated rest; b) Mean diffusivity (MD) trended higher following exercise, but was not significantly different compared to rest. c) Radial diffusivity (D_r) was significantly higher following than exercise than after seated rest.

- [1] M. Reuter, N. J. Schmansky, H. D. Rosas, and B. Fischl, "Within-subject template estimation for unbiased longitudinal image analysis.," *Neuroimage*, vol. 61, no. 4, pp. 1402–18, Jul. 2012.
- [2] S. M. Smith *et al.*, "Advances in functional and structural MR image analysis and implementation as FSL," *Neuroimage*, vol. 23, pp. S208–S219, Jan. 2004.
- [3] J. L. R. Andersson and S. N. Sotiropoulos, "An integrated approach to correction for off-resonance effects and subject movement in diffusion MR imaging.," *Neuroimage*, vol. 125, pp. 1063–1078, Jan. 2016.
- [4] J. L. R. Andersson, S. Skare, and J. Ashburner, "How to correct susceptibility distortions in spin-echo echo-planar images: application to diffusion tensor imaging," *Neuroimage*, vol. 20, no. 2, pp. 870–888, Oct. 2003.

Work in Progress

Bio-Medical/Basic

Brain Networks and Endogenous Pain Inhibition Are Modulated by Age and Sex in Healthy Rats

Joyce T. Da Silva, PhD, Christina Tricou, Youping Zhang, David A. Seminowicz, PhD, and Jin Y. Ro, PhD.*

University of Maryland School of Dentistry, Department of Neural and Pain Sciences, Baltimore

Endogenous pain inhibition is less efficient in chronic pain patients. Diffuse noxious inhibitory control (DNIC), a form of endogenous pain inhibition, is compromised in women and older people, making them more vulnerable to chronic pain. However, the underlying mechanisms remain unclear. Here, we used a capsaicin-induced DNIC test and resting-state functional MRI to investigate the impact of aging and sex on endogenous pain inhibition and associated brain circuitries in healthy rats. We found that DNIC was less efficient in young females compared with young males. Diffuse noxious inhibitory control response was lost in old rats of both sexes, but the brain networks engaged during DNIC differed in a sex-dependent manner. Young males had the most efficient analgesia with the strongest connectivity between anterior cingulate cortex (ACC) and periaqueductal gray (PAG). The reduced efficiency of DNIC in young females seemed to be driven by widespread brain connectivity. Old males showed increased connectivity between PAG, raphe nuclei, pontine reticular nucleus, and hippocampus, which may not be dependent on connections to ACC, whereas old females showed increased connectivity between ACC, PAG, and more limbic regions. These findings suggest that distinct brain circuitries including the limbic system may contribute to higher susceptibility to pain modulatory deficits in the elderly population, and sex may be a risk factor for developing age-related chronic pain.

Published

Bio-Medical/Basic

Role of Intramuscular Fat and Lean Muscle in Surface Electromyography Amplitude of the Gluteus Medius in Older Adults

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Surface electromyography (sEMG) is frequently used to assess muscle activation in older individuals. Subcutaneous fat is one well-known factor that influences sEMG amplitude. The amount of intramuscular fat (IMAT) may negatively impact the muscles ability to produce force with aging, while high density lean tissue (HDL; fat free muscle) has an opposite effect. However, influence of IMAT or HDL on sEMG amplitude remains unclear. Thus, the aim was to investigate the influence of IMAT and HDL on sEMG amplitude of the gluteus medius (GM) muscle during a maximal voluntary isometric contraction (MVIC) in older adults. Twelve older adults (7 females; age: 71 ± 3 y; BMI= 29 ± 4 Kg/m²; $X \pm SD$) underwent a CT scan to determine IMAT and HDL cross-sectional area in the GM. IMAT and HDL were normalized as a percentage of the total muscle area. Maximal hip abduction MVIC was measured at 30° hip abduction in standing, while sEMG was recorded from the GM muscle. Spearman correlations showed a positive association between GM HDL and sEMG amplitude ($r = 0.692$, $P = 0.013$) and negative between GM IMAT and sEMG amplitude ($r = -0.683$, $P = 0.014$). This is the first study to demonstrate the amount of IMAT may limit the ability to activate the hip abductor muscle. Given that muscle activation is a determinant of strength, interventions to lower levels of IMAT and increase levels of lean muscle may be important to showing decreases in strength with aging.

Work in Progress

Bio-Medical/Basic

Colchicine Improves Muscle Function, Enhances Bone Formation, and Reduces White Adipose Tissue in Aged Mice but Not Young Mice

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Background: The skeletal system serves many functions which include locomotion, providing structure, and protecting internal organs. During youth and young adulthood, bone density increases in response to mechanical stimuli ultimately reaching a peak. However, during aging the integrity of bone tissue diminishes as density is reduced, called osteopenia, further compounded by an acquired insensitivity to mechanical stimuli. Reductions in muscle mass and function, called sarcopenia, go hand in hand with osteopenia, resulting in a cycle of frailty in which mobility and balance are impaired and lead to increased bone fracture risk in the elderly. We have recently described a mechano-transduction pathway that is shared between bone and muscle, that hinges on the concept that mechanical response is tuned by the stiffness of the cytoskeleton. Cytoskeletal stiffness is determined in part by a subset of post translationally modified microtubules, specifically detyrosinated microtubules. Not only does this pathway affect muscle and bone function, a bone derived protein, sclerostin, increases white adipose tissue (fat) accumulation, and decreases in response to mechanical loading. Here, we show the abundance of detyrosinated microtubules is increased in the bone and muscle of aged (78-week) mice compared to young (16-week) mice.

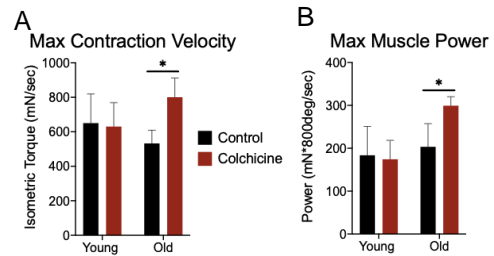


Figure 1. After 8 weeks of colchicine treatment, mice were subjected to *in vivo* muscle testing of the gastrocnemius. **(A)** The maximum contraction velocity, at 150Hz, was significantly increased ($p=0.0316$) in the colchicine treated aged mice but not in the young mice. Data is represented by the mean \pm SD. **(B)** The maximum muscle power, at 800deg/sec, was significantly increased ($p=0.0374$) in the colchicine treated aged mice, but not in the young mice.

Hypothesis

We hypothesized increased detyrosinated microtubules contributes to age dependent defects in muscle function and bone mechano-responsiveness, leading to sarcopenia and osteopenia, and accumulation of WAT. To test our hypothesis, we targeted microtubules *in vivo* with the microtubule destabilizing drug, colchicine, with the expectation that mechano-sensation will be restored, increasing bone formation, improving muscle function, and reducing fat accumulation in aged mice.

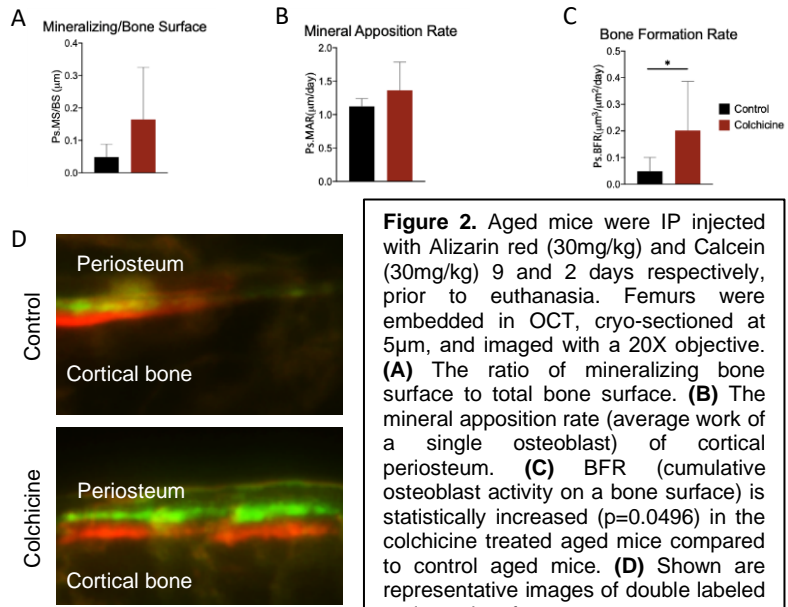


Figure 2. Aged mice were IP injected with Alizarin red (30mg/kg) and Calcein (30mg/kg) 9 and 2 days respectively, prior to euthanasia. Femurs were embedded in OCT, cryo-sectioned at 5 μm , and imaged with a 20X objective. **(A)** The ratio of mineralizing bone surface to total bone surface. **(B)** The mineral apposition rate (average work of a single osteoblast) of cortical periosteum. **(C)** BFR (cumulative osteoblast activity on a bone surface) is statistically increased ($p=0.0496$) in the colchicine treated aged mice compared to control aged mice. **(D)** Shown are representative images of double labeled periosteal surface.

Methods

We treated 16-week old and 78-week old C57BL/6 male mice with colchicine, a microtubule destabilizing drug, at a dose of 1mg/L in drinking water for 8 weeks. *In vivo* muscle measures were collected through electrical stimulation of the gastrocnemius at various frequencies (rate of contraction) and at various velocities (power). Bone formation rates were calculated by measuring the inter-label distance between sequentially injected fluorescent calcium labeling dyes - alizarin red (30mg/kg) and calcein (30mg/kg) - which label the bone surface at the time of injection. Micro-computed tomography (μ CT) of femurs was performed to measure cortical bone parameters. Inguinal and gonadal fat pads were weighed and fixed for histochemistry. Sclerostin was probed for in ELISA from serum, and in western blots from bone derived protein isolate.

Results

Consistent with our hypothesis, these mice exhibited improved *in vivo* muscle contraction velocity (40% increase, $p=0.0106$) and power (20% increase, $p=0.0058$) (**Figure 1**). Additionally, colchicine treated aged mice showed significantly increased bone formation on the cortical surface (300% increase, $p=0.0496$) (**Figure 2**) and decreased bone derived sclerostin. Finally, colchicine treated aged mice showed reduced WAT mass (50% reduction of inguinal fat, $p=0.0199$, 60% reduction of gonadal fat, $p=0.0038$) and adipocyte size (30% reduction, $p<0.0001$) (**Figure 3**). In contrast, young colchicine treated mice, which do not have an over-abundance of detyrosinated microtubules, had no significant effects on bone, muscle or WAT.

Conclusions

Chronic colchicine treatment increased bone formation rate in aged mice, and cortical bone mass trends upwards as well. Bone derived sclerostin protein was decreased by colchicine treatment in aged mice. Surprisingly, circulating sclerostin was unchanged. Muscle performance was improved by increasing maximum rate of contraction and maximum power in chronic colchicine treated aged mice. Inguinal and gonadal fat pads were reduced in size, and fat cells were smaller in colchicine treated aged mice. In contrast, young colchicine treated mice, which do not have an over-abundance of detyrosinated microtubules, had no significant effects on bone, muscle or white adipose tissue. These findings suggest that with additional investigation, the cycle of frailty can be slowed down and possibly even reversed in the ever-growing senior population, enhancing the quality of life for many.

Work in Progress
Bio-Medical/Basic

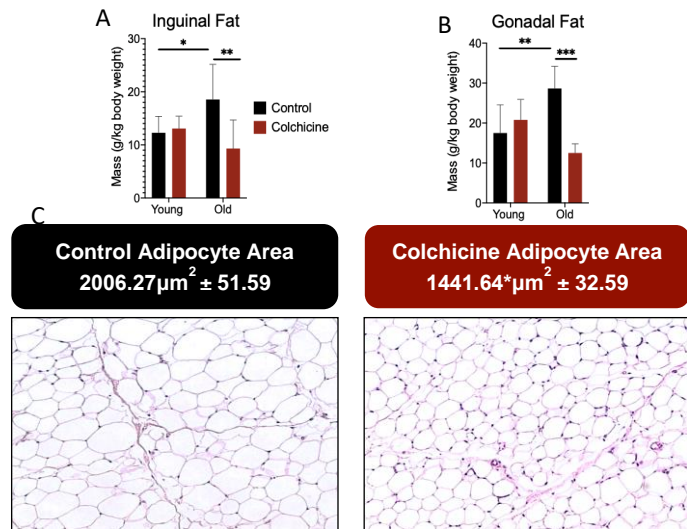


Figure 3. Both inguinal (A) and gonadal (B) white adipose fat pads were collected and weighed after 8 weeks of colchicine treatment. Aged mice have a significant increase in both gonadal ($p=0.0037$) and inguinal ($p=0.0317$) fat pads compared to young mice. Colchicine treated old mice have a significant decrease in gonadal ($p=0.0003$) and inguinal ($p=0.00901$) fat pads compared to age matched controls. Data is represented by the mean \pm SD. (C) Inguinal fat pads from aged mice were fixed and sectioned for Haemotoxylin and Eosin (H&E) staining. Histochemistry of inguinal fat pads show a significant decrease in the average adipocyte cell area ($p<0.0001 \pm$ SEM) in the colchicine treated aged mice compared to the control aged mice.

Sex Difference of β -adrenergic Receptors Agonist Induced Physiological Responses in Isolated Perfused Rat Hearts

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Hypertension prevalence is lower in young women compared to young men; however, older women have impaired vascular pressure regulation than older men. Furthermore, premenopausal women are less likely to have cardiovascular disease than age-matched men and postmenopausal women. Thus, it is very likely sex hormones, especially estrogen, play an important role in CVD prevention. One possible mechanism is that estrogen affects the activity of β -adrenergic receptors (β -ARs), which is the play a role in vascular pressure regulation. By increasing the number of β -ARs or enhancing β -ARs expression, estrogen could increase β -ARs responsiveness. However, it remains unknown how estrogen and β -adrenergic stimulation work independently and synergistically in young male and females.

Purpose: Therefore, the purpose of this study is to evaluate the role of estrogen on the responsiveness male and female rat hearts to β 2-adrenergic stimulation.

Methods: Male and female rats were anesthetized, hearts were excised, and Langendorff-perfused via the aorta at 62 mmHg with a Krebs-Henseleit buffer, pH=7.4, 37°C. While heart rate (HR), coronary flow rate (CFR), and aortic pressure were continually monitored, after 5 min functional equilibration, dose-response curves were generated for either estrogen (17- β -estradiol) alone or the β 2-adrenergic receptor agonist albuterol alone. The 17- β -estradiol dose which caused the greatest degree of vasodilation (20 μ M) were used to evaluate the interaction between estrogen and β 2-adrenergic receptor. In a separate group of male and female hearts, 17- β -estradiol was added to the perfusate, and after steady state function was established in the presence of estrogen, dose-response curves for albuterol were again generated.

Results: Upon addition of albuterol, HR increased from 244 ± 31 to 298 ± 22 beats/min and CFR increased from 14.1 ± 1.4 to 16.9 ± 2.5 mL/min in male rats. In female rats, the response was blunted: HR increased from 236 ± 28 to 252 ± 57 beats/min and CFR increased from 9.8 ± 1.1 to 10.0 ± 2.2 mL/min. In estrogen dose-response experiments, CFR increased from 17.3 ± 3.4 to 19.2 ± 3.7 mL/min in males and from 11.4 ± 0.9 to 12.2 ± 1.8 mL/min in females. In the presence of estrogen, functional responses to albuterol were similar between male and female hearts: albuterol induced a HR increase from 205 ± 78 to 240 ± 57 beats/min and CFR increased from 17.6 ± 0.4 to 20.9 ± 3.4 mL/min in male rats, and HR increased from 235 ± 7 to 310 ± 28 beats/min and CFR increased from 11.1 ± 1.6 to 15.1 ± 1.8 mL/min in female rat hearts.

Conclusion: These data indicate that the cardiac response to β -adrenergic stimulation differs between males and females, and estrogen may be required for β -2 adrenergic stimulation of heart rate in female rat hearts. The findings in this study indicated that estrogen may play an important role in coronary system regulation by affecting β -ARs.

Work in Progress
Bio-Medical/Basic

Sensory-Motor Assessment of the Lower Extremity in Tibial Rotation: Towards Knee Osteoarthritis Rehabilitation

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Introduction

Knee osteoarthritis (OA) is the most common cause for disability in older adults [1]. The objective of this preliminary study is to examine lower-limb sensory-motor properties in tibial rotation (stiffness, ROM, and proprioception) and build new insights for a rehabilitation program on a modified elliptical machine [2], [3].

Methods

Four healthy participants (1 male (S2); 28-42 years old) participated in this study. Each subject had their right knee flexed at 90° and the foot mounted onto a footplate of a modified elliptical machine [2], [3]. The footplate rotated horizontally about the long axis of the tibia using a servomotor. The assembly included a 6-axis force/moment sensor whose vertical axis was aligned with the tibial rotation axis.

During the ROM and stiffness test, an ankle brace was used to reduce ankle rotation. Participants were instructed to relax while the footplate rotated at a constant speed 3°/s until a terminal angle (45°) or a peak moment (5Nm except for subject1's 3Nm) was reached for 5 cycles. The most anomalous cycle (by visual inspection) was removed in Matlab. The remaining 4 cycles were divided into descending limbs and ascending limbs, where a 5th order polynomial was fitted to each limb. Polynomial derivatives yielded the rotational stiffness.

For the proprioception test, subjects (S2-S4) closed eyes and the footplate rotated at 0.8°/s in randomized directions until the subject pressed a hand-held switch when motion was detected. Proprioception acuity was measured 4 times in each direction.

Results and Discussion

The female subjects had a less steep hysteresis curves (Figure 1 and 2) compared to the male subject, which agrees with previous study [4]. Each stiffness curve (Figure 2) has an approximate flat region or subtle ramp in the middle. Since this area contains minimum stiffness, we refer to it as the resting stiffness region.

The resting stiffness may reflect the subjects's preference of toe-in, toe-out, or straight-toe during sitting. For example, S1's resting stiffness is approximately from -25° to 5° suggesting this subject prefers toe-out during sitting. Table 1 summarizes these results and the self-reported preferences.

Some knee OA rehabilitation programs target minimizing external knee adduction moment (EKAM) [2], which can be achieved by the foot progression angle (toe in or out). The current test can potentially give rehabilitation programs a proactive subject-specific strategy (what direction of foot progression angle) to reduce EKAM. However, this should be investigated further because of limitations including: this test is done in a sitting position while EKAM is computed during stepping. The different context (sitting versus standing) may affect the suggested proactive strategy.

The proprioception acuity (Table 2) for female subjects is less than that reported in [3] (3.5°), which may be due to the different context (sitting versus standing with measurements on the weight-bearing side). Improving proprioception acuity through training is an expected outcome as in [3].

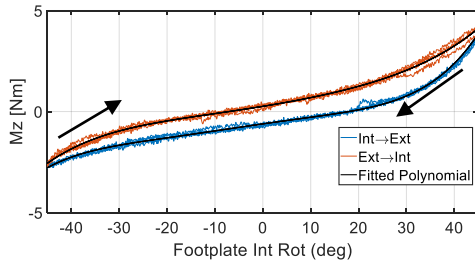


Figure 1: A typical hysteresis curve (for subject#3)

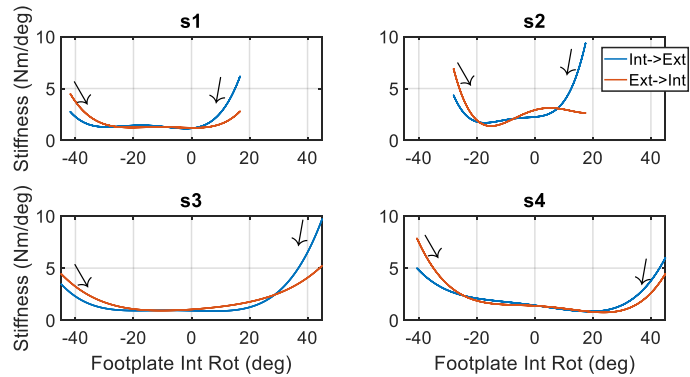


Figure 2: The stiffness curves for each subject

Table 1: Subjects' preference during sitting

	S1	S2	S3	S4
Self-reported	Toe-out	Toe-out	Toe-out	Toe-in
Resting stiffness	Toe-out	Toe-out	Toe-out	Toe-in

Table 2: Subjects' proprioception acuity as mean(SD) in degrees

	S1	S2	S3	S4
External rotate	-	4.35(1.58)	0.94(0.14)	1.64(0.10)
Internal rotate	-	2.75(1.14)	1.20(0.33)	1.64(0.33)

Significance

We suggest a new proactive subject-specific strategy to reduce EKAM via a resting-stiffness principle driven from a sensory-motor assessment of the lower extremity in tibial rotation.

Acknowledgments

L. Zhang has equity positions in Rehabtek LLC, which received federal grants in developing the robotic device used in this study.

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Work in Progress

Bio-Medical/Basic

Temporal Hemiparetic Gait Symmetry Altered by a Nonparetic-Leg Weight

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Introduction

Gait adaptation has shown improved symmetry in hemiparetic stroke survivors. Existing methods typically use expensive equipment such as split-belt treadmills or robotic devices, which may make a translation to the clinic less feasible. Using a unilateral leg weight overground may be a more feasible solution.

We hypothesize that adding a weight to either the paretic or nonparetic side may alter spatiotemporal gait symmetry in subjects with stroke and tested both conditions in short-term experiments.

Methods

Five participants with chronic stroke (2 females; 61.4±2.5 years; 93.3±16.1 kg; 171.8±12.5 cm tall) with unilateral hemiparesis were recruited. They walked over ground without a weight, after adding a weight of 3% body weight on participant's ankle, and after the weight (2.67±0.43 kg) was removed (**Figure 1**). During all conditions, participants were instructed to walk at a comfortable speed with their arms free. For safety, the participant wore a gait belt and a researcher walked close and behind the participant.

The participants were assessed over two visits with at least one week between them. Before visit 1's BL, participants walked on a gait mat to find the leg with the shorter step. The weight was placed on this leg in visit 1 and on the contralateral leg in visit 2. Kinematic data were recorded at 120Hz using VICON.

Step length (SL) and step time (ST) for each leg were calculated using a custom Matlab code. The symmetry index (SI) for a variable X is $SI = (X_{\text{nonparetic}} - X_{\text{paretic}}) / (X_{\text{nonparetic}} + X_{\text{paretic}})$. An SI of zero means perfect symmetry. A repeated-measures ANOVA was performed using SPSS. We considered the repeated measures of the testing periods and paretic-perturbed (PP) versus nonparetic-perturbed (NPP). The interaction was assessed in the model.

Results and Discussion

For step-length SI, ANOVA with repeated measures of testing periods and PP-NPP revealed no significant main effect or interaction effect. Therefore, the PP-NPP groups were merged (Error! Reference source not found., upper panel). An ANOVA with repeated measure of the testing periods revealed no significant effect.

For step-time SI, ANOVA with repeated measures of testing periods and PP-NPP revealed no significant main effects, but a significant interaction ($p=0.044$). A post-hoc analysis revealed no significant difference between PP and NPP at each testing period. However under NPP only, the BL was significantly different from LA, ED, and LD ($p=0.008, 0.033, 0.029$, respectively) (Error! Reference source not found., lower panel).

Taken together, the results suggest that a leg weight does not alter the spatial symmetry of hemiparetic gait, however, it does alter the temporal symmetry when the weight is added to the nonparetic leg. This is a positive outcome since the step time starts asymmetrical in BL (Error! Reference source not found.) and converges to symmetry at the end (LD).

Our results are in line with a study (Khanna et al., 2010) that also reported no change of temporal SI (for % stance duration) when loading on the paretic leg and walking overground.

They differ from previous findings on a treadmill with leg swing resistance of 1.25% body weight (Savin, Tseng, Whittall, & Morton, 2013), where step-length SI was altered. This may be due to the different context of a treadmill, the weight perturbation during swing only, or perturbing the leg with the shorter step regardless of being the paretic or nonparetic. These alternative hypotheses need testing in a systematic manner.

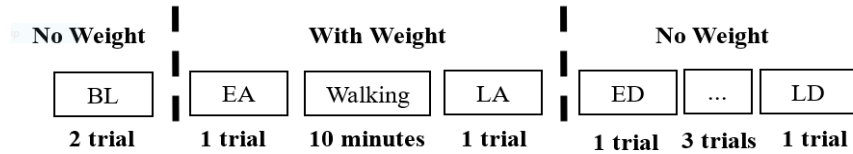


Figure 1: Testing periods. BL =Baseline, EA =Early Adaptation, LA =Late Adaptation, ED= Early Deadaptation, LD= Late Deadaptation.

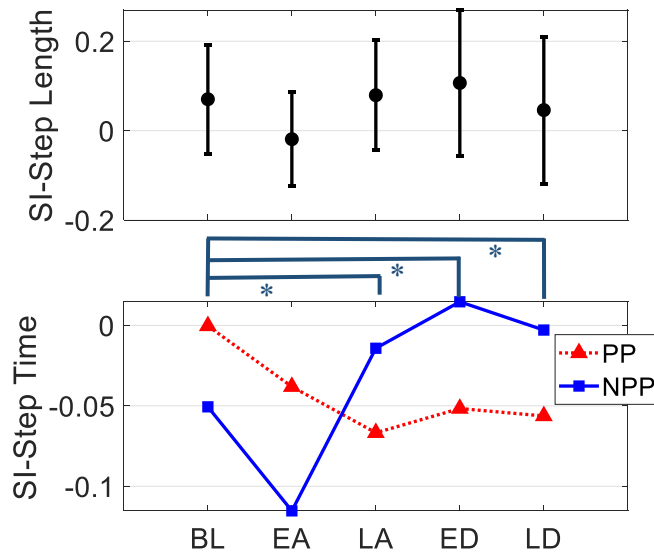


Figure 2: Symmetry index (SI) of step length and time. PP: Paretic Perturbed, NPP: Nonparetic Perturbed. The significant values (denoted by *, $p < 0.05$) are for step-time SI in NPP.

Significance

This study extends the scope of investigating effects of adaptation on overground gait symmetry by testing the effect of perturbing the paretic versus nonparetic sides in individuals after chronic stroke.

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Work in Progress
Bio-Medical/Basic

Clinical Poster Abstracts

Age-Related Changes in Upper Limb and Trunk Responses in Relation to Step Type Following Laterally Induced Imbalances

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Background: Efforts to arrest a fall during imbalances often involve complex coordination of the upper limbs (UL), trunk and leg. In comparison to younger adults, older adults tend to rely more on their UL to restore balance, yet these responses have not been adequately explored.

Objective: To examine age related differences in the UL, trunk, and stepping responses during first and repeated trials during unpredictable lateral perturbations.

Methods: Eleven young adults (25.8 ± 3.46 yrs) and 11 older adults (70.3 ± 5.42 yrs) received 10 trials of right lateral platform translations from a static standing position. Primary outcomes included UL and trunk displacement within 1s of perturbation and at first foot lift off (FFLO), and initial step type. Secondary outcomes included UL EMG and FFLO onset latencies.

Results: Compared to young adults, older adults demonstrated greater angular displacements of lateral trunk flexion, bilateral shoulder abduction and bilateral elbow flexion during the first and last trial, which were present even at FFLO. Resulting steps types were medial, with narrowed base of support, and towards the fall direction in older adults, while lateral, with widened base of support, and opposite to fall direction in young adults. Older adults were delayed in FFLO, but not in UL EMG onsets compared to young adults.

Conclusions: Exaggerated UL and trunk responses that were evident prior to FFLO suggest a potentially influencing role on step type differences between young and older adults. Further research into the role of the UL and trunk on measures of stability during reactive balance recovery is warranted.

Published Work

Clinical

A Case Study of Anterograde Memory Impairment Following Forniceal Infarct– Neurocognitive Sequelae and Recovery

Cyrielle Andrew, PsyD, and Megan M. Smith, PhD

Objective: To describe neurobehavioral consequences and recovery course in a case of acute infarct of the fornix superimposed on chronic subcortical cerebrovascular disease.

Method: We present a right-handed, 72-year-old, African American man with cardiovascular risk factors, chronic kidney disease, and history of CVA with no prior functional or cognitive difficulties. He was evaluated twice, first four days post and again two months post infarct of the bilateral fornix.

Results: Initial inpatient testing revealed impaired verbal memory characterized by rapid forgetting (HVLT-R Delay T = <20) with some benefit from recognition cues, and subtle deficits in constructional praxis and practical judgement. On repeat evaluation at four months post-stroke, he demonstrated memory impairment across modalities (HVLT-R Delay T = <20, BVMT-R Delay T = <20) with marginal benefit from context and cues. He required assistance with multiple instrumental activities of daily living (e.g., financial and healthcare management) and displayed anosognosia of both cognitive and functional deficits.

Conclusion: This case illustrates the role of the fornix in the process of memory encoding and self-awareness. Literature describing the neurobehavioral role of fornix is sparse, however, it has been implicated in episodic memory functions due to hippocampal connectivity. This case study further implicates the fornix in declarative memory formation and will add to the literature by detailing a specific cognitive profile which may inform planning for recovery and rehabilitation.

Work in Progress

Clinical

Reduction of Knee Adduction Moment During Toe-In/Toe-Out Stepping on a Pivoting Elliptical Trainer: Towards Designing a Knee Osteoarthritis Rehabilitation Program

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Medial knee osteoarthritis (OA) is one of the main leading causes of chronic pain and disability in older adults. High occurrence of the medial knee OA is attributed to the knee adduction moment (KAM) that increases loading on the medial compartment. It has been shown that reduction in KAM could be achieved through toe-in/toe-out walking. The purpose of this pilot study is to investigate the effects of different degrees of foot progression angle (FPA) on reducing KAM while stepping, using a custom-designed elliptical trainer. This set up guides the subject to produce less adduction loading on the knee in comparison to over ground walking. A total of 6 healthy subjects (28-40 years old) with no history of lower limb injury participated in this study. A customized elliptical trainer with a 6-axis force plate underneath the footplate and a 6-DOF ankle goniometer was used for knee moment estimation while stepping on the elliptical trainer. Participants were asked to perform stepping on the elliptical trainer for 1.5 minutes with their self-selected comfortable speed in the following 5-footplate positions: neutral position, 5° toe-in/toe-out, 10° toe-in/toe-out. Our results demonstrated reduction in KAM following a change in footplate position, while the FPA that induced this reduction was not the same across subjects. Therefore, these modifications in FPA are effective in reducing KAM during elliptical stepping, similar to modifications in overground walking. Also, these results demonstrate the importance of selecting a subject specific FPA rather than applying a monotonous approach to all individuals.

Work in Progress

Clinical

Socioeconomic and Geographical Characteristics of Medicare Beneficiaries Accessing Medication Therapy Management (MTM) Services

Joshua Chou, PharmD, BCGP, Catherine Cooke, PharmD, Nicole Brandt, PharmD

Background:

Recent studies have demonstrated racial/ethnic disparities in medication therapy management (MTM) eligibility criteria. Limited research exists on socioeconomic/geographical characteristics of those accessing MTM services.

Objective(s):

The objective of this study is to describe the demographic and socioeconomic/geographic characteristics of Medicare beneficiaries who accessed MTM services.

Methods:

As part of a prior study, select Medicare Part D plans distributed a survey to beneficiaries receiving a comprehensive medication review (CMR). Survey respondents could provide their ZIP code. Geographical variables (i.e. National Center for Health Statistics (NCHS) urban-rural classification scheme and economic research service (ERS) county typology codes) were applied to respondents' ZIP codes, allowing for classification of counties by urbanization and economic dependence measures. Descriptive statistics are reported for demographic, geographical and socioeconomic information.

Results:

Of 300 (out of 434) survey respondents providing their ZIP code, 51.3% were 65-74 years, 50.0% were male, and 66.7% had at least a college education. While 82.7% identified themselves as White, 8.0% identified themselves as Hispanic or Black/African American. Most respondents (58.4%) lived in large metropolitan areas. There were also 14.0% of respondents living in federal/state government dependent counties, and 12.7% living in recreation dependent counties.

Conclusions:

Most respondents providing their ZIP codes identified themselves as White and lived in large metropolitan areas. Respondents identifying themselves as Hispanic or Black/African American were not well represented. This study provides geographical/socioeconomic characteristics of Medicare beneficiaries who accessed MTM services, and highlights racial/ethnic differences. Further work is needed to confirm geographical/socioeconomic disparities among beneficiaries accessing MTM services.

Work in Progress

Clinical

The Effects of Cognitive Function on Patient-Reported Outcomes in Parkinson Disease

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Objective

Reliable responses on patient-reported outcome measures (PROMs) depend upon intact memory, insight, and judgment. This study investigates the relationship between cognitive function and patient-reported outcomes in Parkinson disease (PD).

Methods

296 PD patients were divided into 3 subgroups based on cognitive ratings on the Montreal Cognitive Assessment (MoCA): 1) Cognitively Intact (MoCA 26-30; N=160), 2) Mild Cognitive Impairment (MCI; MoCA 20-25; N=97), 3) Cognitively Impaired (MoCA 0-19; N=39). Differences in patient-reported outcomes (PROMIS-29 Profile), and Clinician-reported outcomes (PD severity, disability) were examined by ANOVA. Multivariable regressions examined associations between cognitive status and other outcomes controlling for disease severity and demographics.

Results

The sample was mean age 68.5(9.7) years, 67% male, 86% white, 40% college educated, PD duration 6.6(6.1) years. The 3 cognitive subgroups differed in age, race, PD severity and disability, but not sex or education. Greatest disability was in cognitively impaired group, least disability in cognitively intact group, and intermediate disability in MCI. Significant differences between cognitive subgroups were shown on 4 out of 7 PROMIS-29 measures (physical function, anxiety, depression, social ability, but not fatigue, sleep or pain; $p < .001$). Greater cognitive impairment was consistently associated with greater physical/mental impairment. Multivariable regressions controlling for disease severity, showed PD severity was the strongest predictor of outcomes, but differences by cognitive subgroup remained significant for PROMIS Anxiety.

Table 1: Demographic and PD Severity [Mean (SD) or %] by MoCA

Variables	Impaired (N=39) MoCA 2-19	MCI (N=97) MoCA 20-25	Intact N=160 MoCA 26-30	P
Demographics				
Age (Year)	76.1 (7.0)	69.9 (9.7)	65.5 (39.5)	<.001
Race (% non-white)	24%	21%	7%	<.001
Male Sex (%)	61%	72%	65%	0.38
Education (% college+)	40%	36%	43%	0.45
PD Severity				
Total UPDRS	57.4 (24.5)	39.5 (16.3)	30.0 (41.1)	<.001
Motor UPDRS	36.0 (15.6)	25.8 (11.7)	20.1 (9.7)	<.001
Schwab & England ADL	57.0 (23.6)	78.1 (14.0)	84.1 (11.7)	<.001
PD Duration (Years)	8.2 (6.9)	5.7 (5.8)	6.8 (6.0)	0.04

Table 2: PROMIS-29 and Self-efficacy [Mean (SD)] by MoCA

Variables	Impaired (N=39) MoCA 2-19	MCI (N=97) MoCA 20-25	Intact (N=160) MoCA 26-30	P
<u>PROMIS Profile-29</u>				
Physical Function	35.3 (10.3)	41.8 (9.0)	47.7 (8.9)	<.001
Anxiety	57.1 (11.5)	52.8 (9.6)	50.1 (8.2)	<.001
Depression	54.2 (9.9)	49.8 (8.7)	47.7 (7.7)	<.001
Fatigue	55.1 (10.1)	53.1 (10.0)	51.1 (9.5)	0.09
Sleep	51.7 (10.0)	49.9 (8.5)	49.4 (7.5)	0.62
Social Ability	44.6 (10.7)	48.7 (8.1)	52.7 (8.7)	<.001
Pain	54.6 (12.1)	52.4 (9.4)	50.6 (8.8)	0.08
<u>PROMIS Self-Efficacy</u>				
Manage Daily Activities	39.3 (10.2)	47.6 (8.5)	51.6 (8.6)	<.001
Manage Emotions	45.1 (9.3)	50.0 (9.7)	52.9 (9.0)	<.001
Manage Medications & Treatments	36.5 (14.0)	47.3 (9.9)	51.8 (8.0)	<.001
Manage Social Interactions	46.4 (7.7)	49.6 (7.6)	51.6 (8.0)	<.001
Manage Symptoms	43.3 (9.2)	50.2 (8.4)	51.2 (8.9)	<.001

Conclusions

Cognitive impairment in PD is associated with patient-reports of greater impairment of physical function and mental health. PD patients with cognitive impairment experienced greater anxiety.

This abstract was modified from the following:

Shulman, L. & Gruber-Baldini, A.L. (2019, October). The effects of cognitive function on patient-reported outcomes in Parkinson disease. Paper presentation at the PROMIS® Global Advances in Methodology and Clinical Science conference, San Diego, CA, October 25-26, 2019.
Abstract published at: Journal of Patient-Reported Outcomes 2019, 2019, 3(Suppl 1):68, #O55.

Published Work

Clinical

Effect of Intensive Wearable Ankle Robot Training in Lower-Limb Motor Recovery for Acute Stroke: Preliminary Results

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Background: Stroke-related ankle impairment commonly affects the balance and mobility function of stroke survivors. Early rehabilitation intervention is beneficial for stroke recovery; however, limited evidence exists regarding the in-bed acute stroke ankle rehabilitation training. This study aimed to investigate the effect of intensive wearable ankle robot training on lower-limb motor recovery in individuals with acute stroke.

Methods: Following informed consent, 20 individuals with acute stroke were recruited to either the study group [n=13, female=2, age= 57.5±10.6 years, median poststroke-days: 17.5] or control group [n=7, female=2, age=56.4±19.2 years, median poststroke-days: 28]. The robot-training study group participants received 50-minute robot-guided training including passive stretching and active movement training with real-time audiovisual feedback. Participants in the control group received passive movement in the middle range of motion and active ankle movement without robotic guidance for 50 minutes. The participants were trained 5 sessions/week over the 2-4 weeks hospital stay [number of sessions (median IQR): 14 (12-16)], while receiving regular inpatient rehabilitation. The Fugl-Meyer Motor Scale-Lower extremities (FMLE), Berg Balance Scale (BBS), and Modified Ashworth Scale (MAS) were examined using the Wilcoxon signed-rank test.

Results: The FMLE score was significantly increased in the robot-training study group (p=0.002) and was not significant in the control group (p=0.066). Both groups showed significant improvement in BBS score (p=0.012 and 0.027), and no significant changes in MAS (p=0.463 and 0.418).

Conclusions: Preliminary findings suggest that intensive wearable ankle robot training shows beneficial effects in acute stroke motor recovery. Results quantified with biomechanical measures and larger sample size are warranted.

Work in Progress

Clinical

Whole-Body Vibration Modulates Leg Muscle Reflex and Blood Perfusion Among People with Chronic Stroke: A Randomized Controlled Crossover Trial

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Introduction

Whole-body vibration (WBV), a treatment modality involving the delivery of mechanical stimuli to the lower limbs via a vibration platform, has the potential to manage spastic hypertonia.¹ Although the primary origin of spasticity is impaired reflex function, changes in muscle mechanical properties also occur.² Evidence has suggested that spastic hypertonia has both a reflex component (e.g. hyperreflexia) and a non-reflex component (e.g. muscle passive stiffness).² This study, therefore, aimed to investigate the acute effects of WBV on the reflex (soleus H-reflex) and non-reflex (passive stiffness of MG muscle) components of spastic hypertonia in both the paretic and non-paretic limbs of individuals with chronic stroke. Moreover, we also evaluated the blood perfusion of the MG muscle using power Doppler ultrasound,³ because any changes in circulation induced by WBV may influence mechanical properties of muscle.⁴ It was hypothesized that (1) WBV would result in an inhibition of the H-reflex, decreased muscle passive stiffness and increased muscle blood perfusion in both paretic and non-paretic legs, and that (2) the changes in the aforementioned outcomes would differ between the paretic and non-paretic sides.

Method

Thirty-six people with chronic stroke (age: 61.4±6.9 years) participated in this randomized controlled cross-over study. Each participant underwent two testing conditions: static standing for 5 minutes with WBV (30 Hz, 1.5mm) or no-vibration. We assessed the soleus H-reflex, shear modulus (ultrasound elastography) and vascular index (color power Doppler ultrasound) of the medial gastrocnemius (MG) muscle on either paretic or non-paretic side at baseline and every 1-min post-intervention up to 5 minutes.

Results

The results revealed a significant inhibition of the H/M ratio bilaterally for the WBV condition (absolute change on paretic side: 0.61±0.35, $p = 0.001$; non-paretic side: 0.34 ±0.23, $p = 0.001$), but not the control condition. The inhibition of H-reflex was sustained up to 4 minutes and 3 minutes on the paretic and non-paretic side, respectively. The vascular index of MG muscle was significantly increased only for the WBV condition [paretic: from 0.55± 0.07 to 1.08±0.18 ($p=0.001$); non-paretic: 0.82± 0.09 to 1.01±0.13 ($p<0.001$)], which lasted for 3 minutes and 5 minutes, respectively. No significant change of the shear modulus in the MG muscle was observed, regardless of the testing condition.

This study may have important clinical implications. First, WBV produced an acute inhibitory effect on the H-reflex for stroke survivors, suggesting that it may have potential clinical applications in the management of spastic hypertonia. However, its long-term effect should be investigated in future studies. Second, soleus H-reflex inhibition was found to be associated with improved postural control in healthy adults.⁵ A meta-analysis also revealed that WBV significantly improved balance among older adults.⁶ Therefore, the potential association between H-reflex inhibition and

gains in balance function induced by WBV warrants further research. Third, impaired blood perfusion is common in the paretic limbs after chronic stroke, which may contribute to metabolic dysfunction and functional decline.⁷ Arterial remodeling and increased blood flow could be induced by resistance training,⁷ while WBV was shown to have a comparable effect by increasing microcirculation in the skeletal muscles of young healthy adults.^{8,9} This study also showed that a brief WBV session can increase intramuscular blood perfusion after stroke. Thus, WBV could be a useful training modality for increasing peripheral circulation. This is particularly relevant for frail stroke survivors, who are often unable to perform other forms of exercise. Future research should further elucidate the optimal WBV protocol for stroke patients with different disability levels.

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Published Work

Clinical

The Effect of Support Surface and Footwear Condition on Postural Sway and Lower Limb Muscle Action of the Older Women

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Background: Balance is a major concern for older people. The decline in postural stability in older adults increases the risk of falls that ultimately elevates the morbidity, mortality, and cost of health care services. To maintain the normal static bipedal stance, individuals primarily depend on the proprioceptive and cutaneous input. However, diminished somatosensory function is a critical age-related change which is related to postural instability in the older population. Footwear is a cost-effective way to modulate the postural stability by altering sensorimotor inputs via mechanoreceptors on the plantar surface of the feet. Compared to insoles with indentions in the entire surface, we innovatively developed a textured insole by applying silicone nodules in the metatarsal, heel, and the foot arch area (Figure 1). The underlying mechanism including (1) mechanoreceptors mainly locate in the metatarsal-tarsal and heel region of foot sole¹; (2) investigation regarding electrical site-specific stimulation to these areas has implied consequential improvement of balance²; (3) the raised nodules create a boundary of the plantar surface from the metatarsal heads to the heel that has been suggested to facilitate postural stabilizing reactions evoked by unpredictable postural perturbation³. We proposed that this design would largely maintain users' comfort while facilitates the plantar somatosensory input, particularly in the unstable surface which is common but risk for the older women. This study thus aimed to investigate the immediate effect of the nodulous insole and supporting surface condition on static postural stability and lower limb muscle activation for healthy older women.

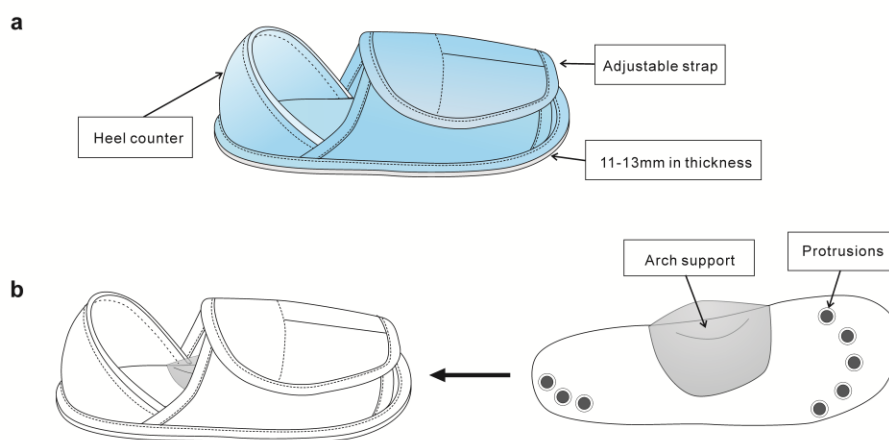


Figure 1 **Test shoe models.** (a) The plain shoes are open-toe design with secured heel counter and an adjustable dorsal forefoot strap. The sole thickness is uniform across the plantar; (b) The nodulous shoes is the same plain shoes with raised nodulous and medial arch support.

Methods: This is a single-session study with repeated measurements. Twenty-three healthy older women (age=65.1± 3.3 years, body mass index=22.2± 3.4) stood on the firm (i.e., concrete floor) and foam surfaces with their eyes open in the three footwear conditions (Figure 1), namely barefoot, plain shoes and shoes with an innovative textured insole, for 30 seconds. Static postural sway quantified by center of pressure and muscle activation of biceps femoris (BF), vastus lateralis (VL), tibialis anterior (TA), and lateral gastrocnemius (LG) of the dominant leg were measured during each testing condition.

Results: Compared to a firm surface, standing on the foam could significantly increase the body sway and lower limb muscle activation ($p < 0.05$). When standing on the foam, compared to barefoot, wearing footwear significantly decreased the VL and TA muscle activation and minimize the postural sway in medial-lateral and anterior-posterior direction, while the influence is larger for the shoes with nodulous insole compared to the plain shoes. No significant differences between the footwear conditions for static stability and muscle activation were observed on firm surface condition.

Conclusions: For older women, footwear could improve the postural stability in the unstable surface, particularly the footwear with nodulous insole, with the underlying mechanism as enhancing the mechanoreceptors on the plantar surface of the feet.

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Work in Progress

Clinical

Risk of Subsequent Cardiovascular Events among Medicare Beneficiaries Diagnosed with Obstructive Sleep Apnea, Treated with Continuous Positive Airway Pressure

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Obstructive sleep apnea (OSA) is associated with an increased risk of cardiovascular disease (CVD). We evaluated the incidence of new CV events among Medicare beneficiaries with and without pre-existing CVD who were newly diagnosed with OSA and subsequently initiated Continuous Positive Airway Pressure (CPAP) therapy.

We conducted a retrospective analysis of a 5% sample of Medicare claims data including adults ≥ 65 years who were newly diagnosed with OSA and initiated CPAP 2009-2013. CVD was operationalized as ischemic heart disease and cardiovascular or peripheral procedures. Person-time at risk was summed from the date of first PAP charge to the earliest of either new CV event date or the end of observation (24 months). Incidence rates were estimated by dividing new CV events by person-months.

4,289 Medicare beneficiaries met study criteria. Mean age was 72 ± 5 years, 90% were white, and 55% were male. 38% had pre-existing CVD and 62% had no prior history of CVD. In the 2-year period following CPAP initiation, beneficiaries without prior CVD had a 10% risk of having a new CV event compared to 74% among those with pre-existing CVD. The incidence rate among those without prior CVD was 5.2 new CV events per 100 person-years (95% CI = 4.6-5.4), compared to 74.5 new CV events per 100 person-years among those with pre-existing CVD (95% CI= 70.4-78.2).

Among beneficiaries newly diagnosed with OSA who initiated CPAP, those with prior CVD history were seven-times more likely to experience subsequent adverse cardiovascular events relative to beneficiaries without pre-existing CVD.

Work in Progress

Clinical

Receipt of Treatment for Depression following Traumatic Brain Injury in Older Adults is Associated with Decreased Health Care Utilization

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Depression is common among older adults following traumatic brain injury (TBI). Evidence suggests that older adults diagnosed with depression following TBI are less likely to receive antidepressant treatment compared to those without TBI. This may be due to concerns about increased risk of adverse events, especially given the limited guidance on treatment of depression following TBI in older adults. To better inform treatment decisions, we estimated the effect of depression treatment (i.e. antidepressants or psychotherapy) on health care utilization (HCU) among older adults newly diagnosed with depression following TBI.

We conducted a retrospective cohort study among adults ≥ 65 years who were diagnosed with TBI 2009-2012 using administrative claims data for privately insured and Medicare Advantage enrollees in the United States. We searched for depression diagnoses and psychotherapy claims using diagnostic and health care procedure codes and obtained antidepressant prescription fills from the drug file. Enrollees were excluded if they received a diagnosis or treatment for depression prior to TBI diagnosis. We operationalized HCU as counts of inpatient, outpatient, emergency department or medication claims per month following depression diagnosis. Rate ratios (RR) were estimated using generalized estimating equations, controlling for demographic factors and pre-existing comorbidities.

We included 6,238 enrollees with a new diagnosis of depression post-TBI. Of these, 66% received ≥ 1 fill for an antidepressant or ≥ 1 psychotherapy claim. Among the treated, 3,120 (76%) received at least one antidepressant fill, 291 (7%) received at least one psychotherapy service and 682 (17%) received at least one of both treatment types. Compared to those not receiving treatment, receipt of any treatment for depression was associated with significantly lower cumulative inpatient (RR 0.93; 95% CI 0.92, 0.95), outpatient (RR 0.97; 95% CI 0.96, 0.97) and emergency department use (RR 0.95; 95% CI 0.94, 0.96), adjusted for treatment in the same month, treatment in the previous month and other relevant covariates.

Treatment of depression following TBI was associated with decreased health utilization among older adults.

Work in Progress

Clinical

Sex-Differences in Bone-Active-Medication Utilization Before and During the Year After Hip Fracture

Kirk, J.M., Orwig, D., Gruber-Baldini, A., Hochberg, M.C., Magaziner, J.S., and Rathbun, A.M.

Abstract: Bone-active medications (BAM), prescriptions (RxBAM) and supplements (calcium/vitamin D), increase bone mineral density and reduce osteoporotic fracture risk. However, RxBAM utilization rates are low, and it is unclear who is treated with these medications before/after a hip fracture. This study examined sex differences in BAM use (at baseline \leq 22 days of admission 2, 6, and 12-months) and predicted RxBAM use during follow-up utilization. The sample included frequency-matched males and females 65+ from the Baltimore Hip Studies' seventh cohort. Differences in baseline characteristics between males and females with complete data ($n=313$) were assessed using t and chi-square tests. Generalized estimating equations were used to predict the probability of RxBAM use by sex among participants ($n=270$) with outcome data during follow-up adjusted for baseline characteristics. Prior to fracture, there were sex-differences in BAM use, with fewer men than women taking RxBAMs (9% versus 26%), calcium (18% vs. 57%) and vitamin D (55% vs. 68%), These differences remained over the year post-hip fracture. Only 12(3.5%) participants took RxBAM the entire study period. Of RxBAM users $n=70$ (26%), there were few new-users ($n=35$) after fracture, and many participants stopped or never started treatment. Unadjusted models showed that men were less likely to use RxBAM (OR= 0.42; 95% CI:0.22,0.78, $p=.007$), during the hip fracture recovery period compared to females. However, after controlling for differences in baseline characteristics between males and females, particularly pre-fracture BAM medication use, the observed association (OR=0.62; 95% CI: 0.29, 1.31; $p= 0.23$). RxBAM use was low, especially in men and contributes to the high rates of preventable subsequent osteoporotic fractures and post-fracture mortality.

Work in Progress

Clinical

Hand Training Effect on Proximal Upper Extremity after Stroke

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Sensorimotor impairments following stroke lead to structural changes in muscles and disruptions in mainly efferent (i.e., descending) pathways, which result in a loss of ability to open the paretic hand and extend fingers. Passive stretching combined with active movement training of the impaired hand facilitates improvement in motor function and mobility post stroke. Specifically, stretching increases joint range of motion (ROM) possibly due to peripheral muscle-tendon changes, where repeated stretching alters the mechanical properties of muscle-tendon units, including the affected muscles, tendons, or joint, by lengthening muscle-tendon units and/or making the muscles/joint less stiff. The combined hand passive-active movement intervention may facilitate neuroplasticity in cerebral cortices and lead to improvements in upper limb function. Furthermore, it may translate into improvement in motor functions involving the proximal upper extremity such as shoulder and elbow function. We investigate the translational training effects of hand on proximal upper extremity in individuals with sub-acute (< 6 months) post stroke. Five stroke survivors participated in this pre- and post-test design study. Each participant completed a course of 18 sessions of intervention training, which focused on impaired hand movement training. Movement of the paretic shoulder, elbow, and wrist were recorded while participants conducted voluntary upper limb movement training with focus on the hand. Preliminary data showed that hand training also affects the proximal arm motor performance and individual differences determine the magnitude of translational training effect of hand on proximal upper extremity.

Work in Progress

Clinical

Sustaining Interprofessional Education in Geriatrics: Reflecting on Milestones for an Aging in Place Program

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Seohwee Ahn, PharmD Candidate, Elodie Tendoh, PharmD Candidate,
Andrew Lee, PharmD Candidate, Betlihem Semma, PharmD Candidate,
Reba Cornman, MSW, Kelly Doran, PhD, RN, Everett Smith, LMSW,
Sarah Holmes, MSW, PhD, Barbara Resnick, PhD, CRNP, FAAN, FAANP, AGSF,
Nicole Brandt, PharmD, MBA, BCGP, BCPP, FASCP*

Background: This geriatric interprofessional educational (IPE) program builds on a foundation of outreach to underserved communities. The relevance of this experience is to scale up and sustain an interprofessional learning program that fosters positive educational and clinical outcomes for students and West Baltimore neighbors.

Objective/Purpose: The primary objective is to grow and sustain an interprofessional course that engages and empowers older adults in West Baltimore.

Methods: Over the span of five years, the program has increasingly involved students from schools both on and off-campus by developing an interprofessional academic course through which students joined a care team. Students kept biweekly reflective journals, and teams met each week to plan educational presentations that ranged in topics relevant to two different sites in the community.

Results: Over the course of 5 years, there have been approximately 125 trainees involved impacting the lives of at least 370 neighbors. There have been over 60 clinical huddles as well as ninety student-led presentations. This has included topics including but not limited to: falls prevention, heart health, substance abuse, nutrition, diabetes, and oral health.

Implications/Conclusion: Sustaining an IPE Program in West Baltimore over the years was manifested by an increase in growth and participation by community residents, number of community locations and participating students. Furthermore, there have been course offshoots with global initiatives with University of Helsinki, Finland as well as expansion of presence through community-university initiatives.

Limitations: Representation across professional schools remains a target for future program expansion as well as consistency in course offerings/expectations.

Work in Progress

Clinical

Distinct Trajectories for Cognitive Performance within the First Year After Hip Fracture

Heather L. Mutchie, Denise Orwig, PhD, Ann Gruber-Baldini, PhD

Introduction: Geriatric hip fracture patients experience heterogeneous pathways of recovery after hip fracture. Knowing what these different groups are can guide rehabilitation efforts.

Objectives: The objective of this study is to illustrate distinct latent trajectories of cognitive performance in older adults in the year following hip fracture using group-based trajectory modeling (GBTM).

Design, Setting, Participants, Measurements: Using 339 hip fracture patients age 65+ recruited to the Baltimore Hip Studies 7th cohort (2006-2011) with a balanced recruitment of men (n=168) and women (n=171). GBTM was used to assess hip fracture patients' cognitive trajectories as measured by the Modified Mini-Mental State Examination [3MS (0-100)], the Hooper Visual Organization Task [HVOT (0-30)], and Trails A and Trails B (0-301s).

Results: Patients on average were 80.91(7.88) years old with 13(3.41) years of education. Three distinct trajectory groups were displayed in the 3MS: a consistently high (76.3%), consistently borderline (17.1%), consistently low performing group (6.4%). HVOT had 4 consistent trajectories: low scoring (14.2%), mid-range (31.9%), borderline (32.4%), well-performed (21.3%). Trails A had 2 trajectories: Consistent high performance (85.3%), declined performance (14.6%). Trails B had 4 trajectories: consistent high-performance (40.2%), improved (18.6%), declined (12.0%), consistent failure (29.1%).

Conclusion: The different tests assess different domains of cognition and the performance trajectories seen in one test may not reflect those in another. Many of groups have similar trajectories but at different magnitudes. 3MS and HVOT scores were consistent, whereas the Trails Tests had more fluctuation over the year. These data show that there is very little change in high or low performing groups, but mid-range patients can experience volatility.

Work in Progress

Clinical

Antidepressant Use in Nursing Home Residents with Dementia

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Introduction: Antidepressant medication use is common among nursing home residents with dementia despite an association with adverse events such as falls, fractures, and hospitalization. The purpose of this study was to describe antidepressant use and evaluate factors that may influence antidepressant use in nursing home residents with moderate to severe dementia.

Methods: This study was a secondary data analysis using baseline data from the Function and Behavior Focused Care for Nursing Home Residents with Dementia repeated measures, randomized control trial. Descriptive statistics were done for sample characteristics. Logistic regression was done to evaluate if age, gender, race, comorbidities, functional status, and agitation were associated with antidepressant use.

Results: The sample was predominantly female, white, and unmarried, with an average Mini-mental status exam (MMSE) of 7.80 (SD:6). Over half the sample was taking antidepressants, and 12% were taking two or more antidepressants. Serotonin selective reuptake inhibitors (SSRIs) were the most common antidepressant drug class, and mirtazapine was the most commonly prescribed antidepressant. The model was significant ($\chi^2=17.780$, $p=0.007$) and explained 7.1% of the variance, with race being significantly associated with antidepressant use (OR=0.51, CI=0.32-0.83).

Conclusion: Like previous research, this study found antidepressant use common in nursing home residents with dementia and expanded understanding of antidepressant prevalence to those with more severe cognitive impairment. This sample consisted of a large number of black residents. It was found they were less likely to receive an antidepressant, which is consistent with community-based research. Future research should explore racial differences and indications of use for antidepressants in this vulnerable population.

Work in Progress

Clinical

Walking to Alter Biologic Mechanisms of Frailty in Persons Living with HIV

Amy Nelson, MS, BSN

Background: People living with HIV now have nearly equal lifespans to the general population, yet they experience frailty, a vulnerability to stressors caused by lack of physiologic reserves, more often and ten years earlier than those without HIV. In geriatrics, frailty is associated with decreased muscle strength and increased systemic inflammation. Less is known about mechanisms driving early frailty in HIV or effective interventions for this aging population.

Impaired cellular energy metabolism by mitochondria may contribute to the muscular weakness and ongoing inflammation accompanying frailty in HIV and driving early presentation. This study will examine the impact of six weeks of moderate exercise on cellular energy metabolism, inflammatory markers and frailty phenotype in people living with well-controlled HIV.

Research Plan: Fifteen subjects with HIV, aged 50 to 65, will be recruited to complete three study visits over twelve weeks. Each visit will assess frailty score, collect blood samples for cellular oxygen consumption testing, inflammatory markers and complete questionnaires on pain, depression, polypharmacy, comorbidities and duration of infection. After visit two, subjects will complete six weeks of an aerobic exercise intervention, with 30 minutes of escorted walking at 100 steps/minute three times weekly.

Expected Outcome: The addition of moderate aerobic activity is expected to increase cellular oxygen consumption and decrease inflammatory markers in this population. These changes are expected to correlate with frailty phenotype and highlight the ability of the mitochondrial mechanisms of frailty to be altered by simple physical activity.

Work in Progress

Clinical

Neurocognitive Measures Predict Voluntary Stepping Performance in Older Adults Post-Hip Fracture

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**University of Maryland School of Medicine*

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Objectives: To determine the relationships between Trail-Making Test performance and parameters of the choice stepping reaction time test (CSRT) in community-dwelling older adults after hip fracture.

Design: Cross-sectional study.

Setting: University-based laboratory.

Participants: Twenty-four community-dwelling older adults post hip fracture in an ancillary study for physical therapy interventions (mean age 79, range 67-92).

Measurements: Baseline Trail-Making test (Trails A & B) scores, movement time (time from foot liftoff to touchdown) step speed, reaction time (time from cue to foot liftoff), and total response time (time from step cue to touchdown) in the forward and lateral directions. Paired T-tests and multiple linear regressions were used for data analysis.

Results: Significant differences in movement time, speed and reaction time between limbs in the lateral direction, and in movement and reaction time in the forward direction. Trails A predicted step speed, reaction time and total response time for the fractured limb in the lateral direction, as well as reaction time and total response time in the forward direction. However, Trails A could not predict performance for the non-fractured limb. Trails B predicted stepping performance for both limbs in the forward and lateral directions.

Conclusion: Trails A correlated with the fractured limb's ability to perform a choice reactive stepping task, but not the non-fractured limb. Meanwhile, Trails B correlated with stepping performance in both limbs, suggesting those with poorer executive function have a lower protective stepping capability and may be at a higher risk for future falls and injury.

Work in Progress

Clinical

Physical Performance Measures in Older Women with Urinary Incontinence: Pelvic Floor Dysfunction or Geriatric Syndrome

Tatiana V.D. Sanses, MD, MS, Sharee Pearson, Derik Davis, MD, Chi Chiung Grace Chen, MD, MPH, Soren Bentzen, PhD, Jack Guralnik, PhD, Holly E. Richter, PhD, MD, Alice Ryan, PhD

Abstract:

Objective: Associations between urinary incontinence (UI) and functional limitations in older women suggests a common pathophysiology. The objective was to evaluate the correlations of Modified Physical Performance Test (MPPT), Short Physical and Performance Battery (SPPB), and other physical performance measures, including “Timed Up and Go” (TUG) test, in older women with UI.

Methods: In a cross-sectional study, twenty women age ≥ 70 years with UI completed standardized functional status evaluations, validated UI questionnaires, and 3-day bladder diary. Lower scores for MPPT (range 0-36) and SPPB (range 0-12) indicated greater functional limitations. Spearman correlation coefficients between physical performance and UI measures were calculated.

Results: Mean age and BMI of participants was 76.6 ± 4.7 years and 33.5 ± 9.0 kg/m², respectively. Mixed UI was the most prevalent type of incontinence (n=17, 85%). The Global Severity Impression Scale revealed moderate and severe UI symptoms in 12 (60%) and 2 (10%) women, respectively. UI questionnaires revealed moderately bothersome symptoms and impact of UI on daily activities. Mean MPPT and SPPB scores were 26.55 ± 7.1 and 9.35 ± 2.7 , respectively (Table 1). Lower MPPT score correlated with greater UI impact on daily activities ($r = -0.46$, $p = 0.04$) (Table 2). Worse performance on TUG test moderately correlated with greater UI impact on daily activities ($r = 0.5$, $p = 0.03$). The SPPB did not significantly correlate with UI severity based on any UI questionnaires (all $p > 0.05$) (Table 2).

Conclusions: Correlations between MPPT score, TUG performance, and UI impact on daily activities suggest that these physical performance measures should be utilized in future research exploring pathophysiology of UI and functional limitations in older women.

TABLE 1. Physical Performance Measures of Mobility and Strength in Older Women with Urinary Incontinence

	N (%)	Mean (SD)	Median (range)
SPPB Score (0-12)	20 (100%)	9.4 (2.7)	10.00 (3-12)
MPPT Score (0-36)	20 (100%)	26.6 (7.1)	28.00 (7-34)
TUG, Secs	20 (100%)	10.4 (7.3)	7.7 (4.9-37.9)

TABLE 2. Spearman Correlation Coefficient between Physical Performance Measures and Urinary Incontinence in Older Women

	UDI-6	IIQ-7	MESASTRS	MESAURGE	UI*	PGI-S
SPPB	-0.27	-0.39	-0.33	-0.21	0.01	-0.14
MPPT	-0.33	-0.46*	-0.34	-0.22	-0.07	-0.19
TUG, secs	0.26	0.50**	0.33	0.33	-0.09	0.37

UDI-6 – Urogenital Distress Inventory Short Form

IIQ-7 – Incontinence Impact Questionnaire Short Form

MESASTRS – The Medical Epidemiologic Social Aspect of Aging (Stress Urinary Incontinence)

MESAURGE – The Medical Epidemiologic Social Aspect of Aging (Urgency Urinary Incontinence)

*UI – urinary incontinence based on bladder diary

GSI – Patient Global Impression of Severity

*P = 0.04

**P = 0.027

Published Work
Clinical

Handgrip Strength, A Proxy Marker for Pelvic Floor Integrity in Older Women with Urinary Incontinence

Tatiana V.D. Sanses, MD, MS, Sharee Pearson, Derik Davis, MD, Chi Chiung Grace Chen, MD, MPH, Soren Bentzen, PhD, Jack Guralnik, PhD, Holly E. Richter, PhD, MD, Alice Ryan, PhD

Background: It has been suggested that age-related decline in muscle strength and physical performance in older women is associated with increased incidence of urinary incontinence (UI) due to reduced coordination and strength in pelvic floor muscles. However, age-related changes in pelvic floor muscles in older women with UI are not well understood.

Objectives: 1) To evaluate pelvic floor muscle strength in older women with UI; 2) to correlate pelvic floor muscle strength with UI severity and physical performance measures.

Methods: Twenty women age ≥ 70 years with UI met study criteria and completed validated UI questionnaires and 3-day bladder diary. The pelvic floor examination included strength assessment and observation of the pelvic floor muscle's ability to contract and relax. Kegel muscle strength was graded utilizing the Oxford scale, where 0 indicated lack of muscle response, 1 – flicker of non-sustained contraction, 2 – presence of contraction of low intensity but not sustained, 3 – moderate contraction, felt as increase in intravaginal pressure; 4 – satisfactory contraction, and 5 – strong contraction. Physical performance measures included Short Physical and Performance Battery (SPPB), Modified Physical Performance Test (MPPT), gait speed, grip strength, chair rise, and “Timed Up and Go” (TUG) test. Spearman correlation coefficients were calculated.

Results: The mean age and BMI of participants was 76.6 ± 4.7 years and 33.5 ± 9.0 kg/m², respectively. Most women (75%) had vaginal deliveries. Ninety-five percent of older women had poor strength in pelvic floor muscles. Three women (15%) had pelvic floor muscle strength graded as “lack of muscle response”, 9 (45%) graded as “flicker of non-sustained contraction”, 7 (35%) - “presence of contraction of low intensity but not sustained”, and 1 (5%) - “satisfactory contraction”. Pelvic floor muscle strength negatively correlated with UI severity based on at least one validated UI questionnaire (Table 1). Pelvic floor muscle strength positively correlated with hand grip strength ($r=0.50$, $p=0.03$), and negatively correlated with time needed to perform chair rise test ($r=-0.48$, $p=0.05$).

Conclusions: Pelvic floor muscle strength was poor in 95% of older women with UI. The positive correlation between pelvic floor and hand grip strength supports applying hand grip strength as a proxy marker for pelvic floor integrity in older women with UI. The correlations between pelvic floor muscle strength, hand grip strength, and chair rise test support previous observations regarding age-related decline in muscle strength and physical performance in older women with UI.

Table 1. Spearman Correlation Coefficient between Pelvic Floor Muscle Strength, Urinary Incontinence, and Physical Performance Measures.

Outcomes	UDI-6	IIQ-7	MESASTRESS	MESAURGE	UI episodes	PGIS
Correlations						
Pelvic Floor Strength (Oxford Scale 0-5)	-0.09, p=0.7	-0.32, p=0.18	-0.47, p=0.039	-0.55, p=0.01	-0.08; p=0.73	-0.21, p=0.37

Outcomes	SPPB	MPPT	Gait Speed, meter/sec	Hand Grip, kg	Chair Rise, sec	Time Up and Go, sec
Correlations						
Pelvic Floor Strength (Oxford Scale 0-5)	0.22, p=0.39	0.25, p=0.3	-0.03, p=0.89	0.50, p=0.03	-0.48, p=0.05	-0.23, p=0.32

UDI-6 – Urogenital Distress Inventory Short Form

IIQ-7 – Incontinence Impact Questionnaire Short Form

MESASTRS – The Medical Epidemiologic Social Aspect of Aging (Stress Urinary Incontinence)

MESAURGE – The Medical Epidemiologic Social Aspect of Aging (Urgency Urinary Incontinence)

*UI – urinary incontinence based on bladder diary

GSI – Patient Global Impression of Severity

Published Work

Clinical

Self-Efficacy as a Predictor of Outcomes

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University of Maryland School of Medicine
Department of Neurology and Department of Epidemiology and Public Health

Objective

To investigate self-efficacy (SE) for managing chronic conditions as a predictor of outcomes in Parkinson's disease (PD), across the 5 PROMIS self-efficacy domains.

Background

- Self-efficacy is defined as one's confidence in managing chronic conditions, in both normal and stressful conditions.
- Self-efficacy is a key determinant of health outcomes. Longitudinal studies show that greater self-efficacy is associated with better self-management skills and better outcomes in heart disease, chronic renal failure, MS and stroke.
- *Low self-efficacy results in self-imposed limitations beyond the severity of impairments* (Tinetti 1993)



Methods

293 PD patients were identified with one-year longitudinal data including:

- 1) PROMIS Self-Efficacy for Managing Chronic Conditions
- 2) PROMIS Profile-29 and Global Health
- 3) Unified Parkinson's Disease Rating Scale (UPDRS)

The 5 PROMIS Self-Efficacy domains are:

- 1) Managing Daily Activities
- 2) Managing Symptoms
- 3) Managing Medications and Treatments,
- 4) Managing Emotions
- 5) Managing Social Interactions

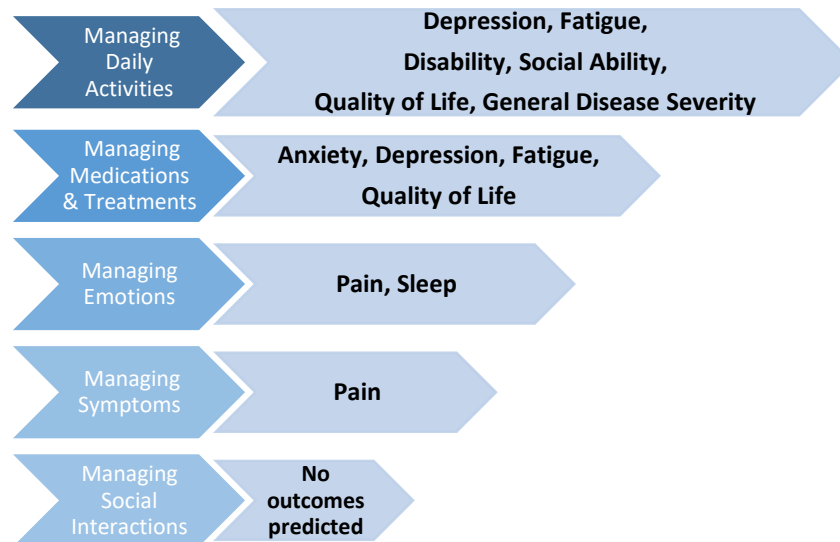
Data Analysis: Multivariable regressions predicted 1-year outcomes for the PROMIS-29, PROMIS Global Health and UPDRS, by the 5 Self-Efficacy domains, controlling for baseline characteristics (baseline value of each outcome, demographics (age, sex, race, education), medical co-morbidity (CIRS-G), and disease progression (PD duration, UPDRS motor and total, and physician-rated disability (Schwab and England ADLs).

Summary of Results

- Baseline Self-Efficacy for Managing Daily Activities independently predicted the most outcomes after one-year including depression, fatigue, physical functioning, social ability, UPDRS Total and PROMIS Physical and Mental Global Health ($p < .0001$ to $p < .05$).
- SE for Managing Medications predicted anxiety, depression, fatigue and Mental Global Health.
- SE for Managing Emotions predicted pain intensity, sleep and UPDRS Total, but no mental health outcomes.
- SE for Managing Symptoms predicted only pain intensity.
- SE for Managing Social Interactions was not an independent predictor of any outcome including ability to participate in social roles/activities.
- Only one outcome was not predicted by any SE domain- the clinician-reported UPDRS Motor Examination.

Conclusions

- The 5 domains of PROMIS Self-Efficacy for Managing Chronic Conditions independently predict different disease outcomes.
- SE for Managing Daily Activities predicted the greatest number and range of outcomes including mental health, fatigue, disability, social activity and general PD severity.
- A dichotomy of outcomes prediction was found between the different SE domains: Managing Daily Activities and Medications (disability/mental health outcomes) vs. Managing Emotions and Symptoms (pain/sleep).
- Notably, the only outcome not predicted by baseline SE was the most objective outcome (motor function based on neurologic exam).
- This study confirms previous evidence that self-efficacy for managing chronic conditions is a potent predictor of disease outcomes. Data on self-efficacy in different PROMIS domains can be used to guide management based on individual risk profiles.



Intensive Sensorimotor Rehabilitation of Acute Stroke Survivors with Severe Hemiplegia Using a Wearable Ankle Robot

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College Park

Abstract

Background and aims:

Stroke is the leading cause of adult disability, and the recovery of motor function after stroke is the key for patients to regain independence. The acute phase poststroke is critical for neuroplastic change and motor recovery. However, in this phase sensorimotor movement training is difficult and usually not the therapeutic focus, especially in patients with initial severe impairments. This study investigated the effect of combined rehabilitation approaches involving real-time feedback, robot-guided stretching and active movement training in acute stroke survivors with severe hemiplegia using a wearable ankle robot.

Methods: Acute stroke survivors with initial severe hemiplegia were enrolled in this study. All the patients were within 3-month post stroke and had no active ankle movement at baseline. Robot-assist ankle training was given 50 minutes per session, 5 times a week using a wearable ankle robot during their hospital stay. The study group received robot-guided motor relearning under real-time feedback, intelligent stretching and active movement training with interactive videogame, while the control group received passive ankle movement in middle range of motion and active movement training without robotic guidance.

Clinical and biomechanical measures were obtained before and after the training. The primary outcome is Fugl-Meyer Assessment of Lower Extremity (FMLE). The biomechanical measures included active range of motion in dorsiflexion (AROM_DF) and plantar flexion (AROM_PF), and the isometric strength of plantar flexor (PF) and dorsiflexor (DF), which measured by maximal voluntary contraction (MVC). Each assessment was taken 3 times and the average value was recorded. Baseline characteristics were compared between the two groups by Student's t-test or Fisher's exact test. A mixed analysis of covariance (ANCOVA) was used to compare the outcome measures by time x group with the therapy sessions as the covariance. Significance level was set at 0.05.

Results: Nineteen patients with acute/subacute stroke were included in this study, assigned to the study group (n=10) and the control group (n=9). The onset ages were 59.8 ±12.5 vs 55.6 ±18.9 years and the duration post stroke were 28.4 ±18.6 vs 24.9 ±17.1 days in the study group and control group, respectively. FMLE scores at baseline was comparable in the two groups, 4 (range 0-14) in the study group vs 7 (range 2-13) in the control group. Baseline characteristics had no significant differences between the two groups. The median therapy sessions were 13 (range 7-15) in the study group and 9 (range 5-15) in the control group.

A significant time x group effect was found for AROM_PF (p=0.020, partial eta-square=0.292), MVC_PF (p=0.020, partial eta-square=0.310), and FMLE (p=0.014, partial eta-square=0.338).

The outcome showed FMLE and biomechanical measures in the study group were significantly improved in comparison to that in the control group. Though all the outcome measures showed improvements in both groups after multiple training sessions, however, no significant main effect on time.

Conclusions: This preliminary study showed robot-guided motor relearning under real-time feedback, intelligent stretching, and active movement training is an effective rehabilitation strategy for motor recovery in acute stroke survivors with severe hemiplegia. Robot-assist therapy facilitates early intensive rehabilitation with less personnel and physically demanding for the therapists. Furthermore, this approach provides a standardized motivated training environment and allows an objective assessment and early detection of the re-emerging motor recovery changes achieved during the course of rehabilitation to engage patients under real-time feedback, especially in this challenging subgroup of severe impaired patients.

Work in Progress

Clinical

Social/Behavioral Abstracts

Measurement of the Assisted Living Environment and Influence on Function and Physical Activity

Holmes, S.D., Resnick, B., Galik, E.

Assisted living (AL) residents engage in limited amounts of physical activity and decline in function more rapidly than their peers in nursing homes. AL settings often have barriers to keeping residents physically active which can contribute to adverse events including falls and hospitalizations. Environmental findings such as access to safe walking areas, age appropriate exercise equipment, and access to outdoors have been associated with physical activity in AL settings. This study tested the reliability and validity of the Function Focused Environment Assessment (FFEA) and examined associations with the function and physical activity among AL residents. Baseline data from the Dissemination and Implementation of Function Focused Care in AL study was used in this analysis. A total of 242 AL residents were included in the sample. Based on Rasch analysis, there was evidence of internal consistency (alpha coefficient of .92) and validity based on INFIT and OUTFIT statistics all in the acceptable range of 0.4 to 1.6. Item mapping showed that the hardest item to endorse was item 5, evidence of cues in the environment to encourage physical activity. The easiest item to endorse was evidence of slippery floors. More challenging items are needed to better differentiate those scoring high in Function Focused Environments. There was not a significant association between scores on the FFEA and function or physical activity among residents. The FFEA can be used to evaluate AL environments and identify areas to improve these settings to promote the function and physical activity of residents.

Work in Progress

Social/Behavioral

An Investigation into the Behavioral Effects of Targeted Memory Reactivation During Sleep on Sensorimotor Skill Performance in Older Adults With and Without a History of Stroke

Brian Johnson, OTR/L, PhD, Kelly Westlake, PT, PhD

Background. Memory consolidation occurs during sleep, providing an opportunity to enhance upper extremity (UE) function in people post-stroke. Targeted memory reactivation (TMR) involves pairing auditory cues with task performance and subsequent cue replay during sleep and leads to increased task-related brain network connectivity and behavioral performance in healthy young adults. It remains unknown whether TMR can enhance sensorimotor performance in individuals with stroke.

Methods. Participants were trained on a throwing task before a period of waking or sleeping consolidation, with some receiving TMR throughout the consolidation period. Study 1 involved the use of TMR throughout the first two slow wave sleep periods over a full night of sleep with young adults. Studies 2, 3, and 4 investigated whether TMR throughout a one-hour nap was sufficient to influence sensorimotor performance in young adults, older adults, and people with a history of stroke, respectively.

Results. All studies found that TMR application during sleep enhanced sensorimotor performance. TMR during wake enhanced performance of a cognitive aspect of the trained task. Additional generalization and transfer tests helped to support that TMR enhanced a task-specific motor program, as improvements were only seen within the trained task. Lastly, sleep alone appears to stabilize sensorimotor performance variability, but this process demonstrates an age-related decline.

Conclusion. The use of TMR during sleep is a useful method for enhancing sensorimotor performance in healthy young and old adults, as well as individuals with a history of stroke. Future research may lead to an adjunct to traditional physical rehabilitation protocols.

Work in Progress

Social/Behavioral

Differences in Staff-Resident Interactions between Male and Female Residents in Nursing Homes

Rachel E. McPherson, BS, Barbara M. Resnick, PhD, CRNP, & Elizabeth Galik, PhD, CRNP

Communication and interactions are an integral part of care in long-term care settings. Quality of staff-resident interactions are essential to assess in person-centered care and are considered a key indicator of quality of care. Social disengagement and isolation are associated with severe cognitive impairment. In nursing home populations, nurse-patient interactions significantly relate to perceived meaning of life. Additionally, meaningful communication has been shown to decrease depression ratings of dementia residents.

To assess social interactions in long-term care facilities, the Quality of Interactions Schedule (QuIS) was originally developed to measure the length and quality of verbal and nonverbal interactions among nursing staff and older adults of nursing homes and a hospital ward and the interactions were categorized into positive, neutral, or negative. The QuIS was later modified to distinguish between different types of positive and negative interactions continuum: Positive Social, Positive Care, Neutral, Negative Protective, and Negative Restrictive. The use of the measure has been descriptive in nature and used to identify the percentage of care interactions that were positive social, positive care, neutral, negative protective or negative restrictive over a predetermined observation period.

The purpose of this study was to describe the gender differences in the quality of interactions. The data for this analysis was obtained from the EIT-4-BPSD study: Evidence Integration Triangle for Behavioral and Psychological Symptoms of Dementia (Resnick et al., 2018). A total of 553 observations were recorded between staff and residents from 55 settings.

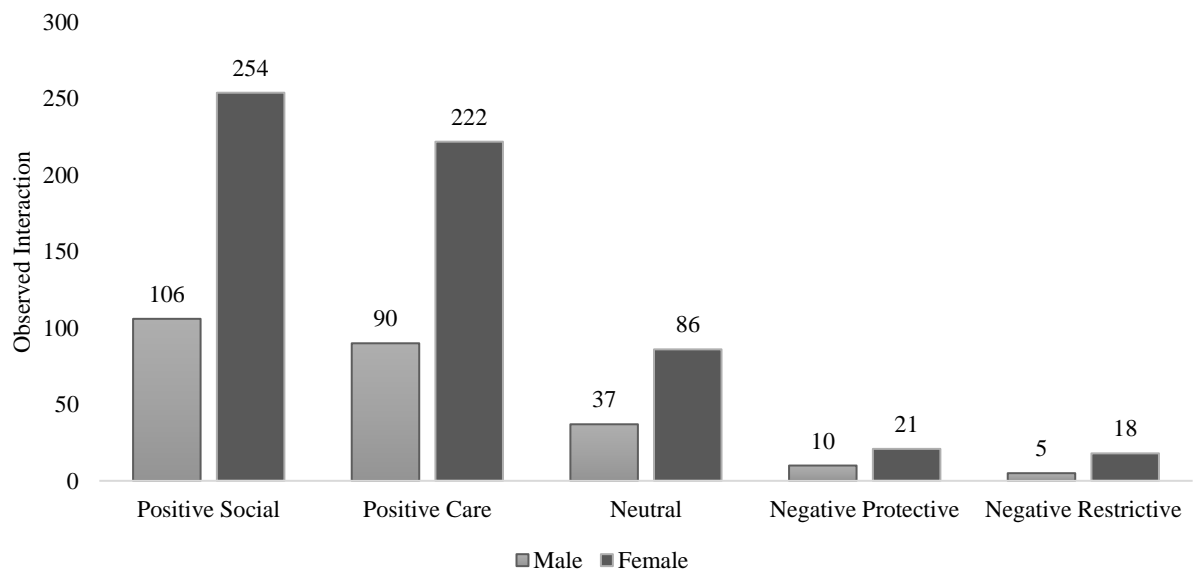
The majority of the staff-resident interactions were positive including Positive Social (42%) or Positive Care (37%). However, 15% of the interactions were Neutral, 4% were Negative Protective, and 3% were Negative Restrictive. As shown in Table 1, there were no significant differences in quality of interaction between male and female residents.

Although previous literature has suggested that the rate of interactions was influenced by gender, the findings from this analysis suggest that the quality of interaction (Positive Social, Positive Care, Neutral, Negative Protective, or Negative Restrictive) does not differ between male and female residents. The majority of the caregivers in this study were females. We do not know if the outcomes would be different if male caregivers were interacting with these residents. Although the majority of the interactions observed were positive, there was still a good percentage that were neutral or negative. Staff education should focus on helping staff to avoid these types of interactions at all times. Future research needs to continue to explore the impact of positive and negative interactions on residents and develop and test interventions that help assure staff provide more positive and less neutral and negative interactions when working with residents. A majority of care interactions were observed in resident rooms and the dining room. Future work should focus on including care interactions that occur during other activities such as bathing, toileting, and med administration.

Table 1. Sex Differences in Quality of Staff-Resident Interaction

	n		Chi-square	p-Value
	Male	Female		
Positive Social	106	254	1.08	.29
Positive Care	90	222	.97	.62
Neutral	37	86	.70	.70
Negative Protective	10	21	.29	.59
Negative Restrictive	5	18	.47	.49

Figure 1. Descriptive Characteristics for Quality of Interaction by Gender



Work in Progress

Social/Behavioral

Serving our Geriatric Population in West Baltimore Maryland by Leading an Interprofessional Intervention

Lori Edwards, DrPH, MPH, RN, APHN-BC, Sarah Heaps (MD Candidate), Gabriella Miller (MD Candidate), Jennifer Miller (PharmD Candidate), Vishnu Rao (MD/PhD Candidate), Patricia Tyson (MD Candidate), Daniel Z. Mansour, PharmD, BCGP, FASCP.

In 2008 both the National Academy of Medicine and the American Geriatrics Society produced recommendations emphasizing the importance of interprofessional teams in working with older adults^{1,2}. There have been many attempts to create curricula for IPE experiences related to geriatrics^{3,4,5}, but few university-wide interventions for students to participate in longitudinal IPE opportunities for older adults⁶. This project describes the establishment of The University of Maryland Baltimore Health Alliance (UMBHA), a health education program that provides health care coordination and addresses the social determinants of health needs of residents in West Baltimore, MD neighborhoods, through interprofessional teams of students and faculty. UMBHA's central theme is promoting heart health, the leading cause of death in individuals >65 years of age⁷. We hypothesized that the UMBHA model is a feasible opportunity for students to work in IPE teams, learn critical principles in the care of geriatric adults in community-based settings with the guidance of UMB IPE Faculty. Over the first 8 UMBHA events, 94 student volunteers and 18 faculty volunteers from the Schools of Dentistry, Law, Medicine (MD and DPT programs), Nursing, Pharmacy and Social Work worked with 25 community members. Approximately 1/3 (32%) of the community members were aged >65. Common issues participants stated as health goals included "diabetes control," "dental care," "exercise," "mental health," and "weight control." Although most community participants were not aged >65, we anticipate that there is a large population of older adults in West Baltimore that we have not yet been able to reach.

Work in Progress

Social/Behavioral

A Theoretically Informed mHealth Intervention to Improve Medication Adherence by Adults with Chronic Conditions: Technology Acceptance Model-Based Smartphone Medication Reminder App Training Session

Daniel Y. Park, PhD, Elizabeth M. Goering, PhD, Katharine J. Head, PhD, Rebecca J. Bartlett Ellis, PhD, RN ACNS-BC, Marianne S. Matthias, PhD

Chronic conditions are a leading cause of mortality and account for healthcare costs of as much as \$3.3 trillion per year in the United States. Medication adherence is critical to managing chronic conditions and reducing the risk of hospitalization and mortality. Middle-aged to older adults comprise three-quarters of U.S. adults with chronic conditions and appear to be a group at risk for medication nonadherence. They often report medication nonadherence for reasons such as forgetting to take or fill medications as prescribed. Forgetfulness in this group might be attributable to polypharmacy and age-related cognitive impairment factors.

Smartphone medication reminder apps (SMRA) that help users visually keep track of their prescribed medication information (e.g., dosing schedule) and send reminders to users when it is time to take medications have been found effective in supporting medication adherence. However, the self-adoption and use of SMRAs could be challenging for middle-aged to older adults with chronic conditions in the presence of age-related limited eHealth literacy or an ability to understand and use such technology for better healthcare.

A pilot study indicated the feasibility of a technology acceptance model (TAM)-based SMRA training—an intervention designed to target perceived usefulness of the app, perceived ease of app use, and positive subjective norm regarding app use—as a way to increase the level of intention to use the app among middle-aged to older adults with chronic conditions. This research project assessed the effect size of the TAM-based SMRA training in promoting app use and medication adherence, as well as its delivery design in preparation for a larger efficacy study (see Figure 1).

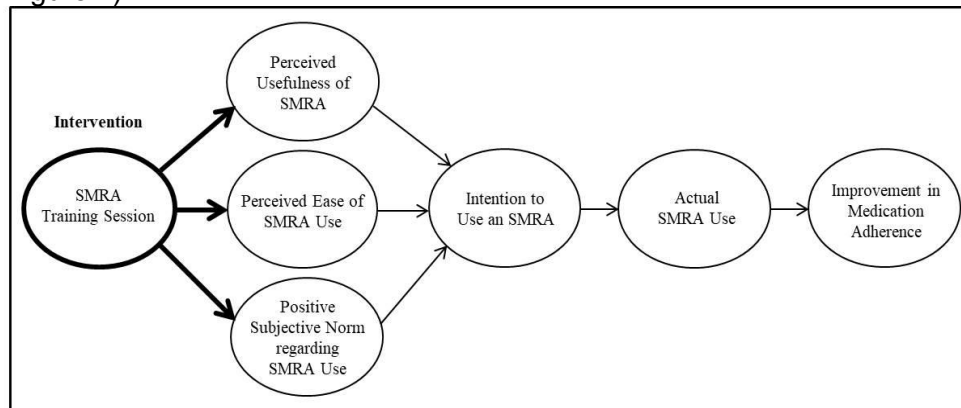


Figure 1. Framework describing participants' progress from receiving the TAM-based SMRA training to improving medication adherence using the app

Twenty-nine adults aged over 40 years and taking medications for chronic condition management were recruited from Midwestern university and community sites. A two-group pretest-posttest and multi-method study design was employed. The training group ($n = 15$) received the TAM-based SMRA training. To target perceived usefulness, training group participants learned about SMRA features that might help address their potential struggles in medication adherence. To target positive subjective norm, training group participants learned about the situations in which family members and health care providers would find value in participants' SMRA use. To target perceived ease of use, training group participants received

step-by-step instructions on app use. The non-training group ($n = 14$) self-navigated app features. To assess the effect size of the TAM-based SMRA training in promoting app use and medication adherence, both training group and non-training group participants completed a three-time survey. To gain insight into how to improve the delivery of the TAM-based SMRA training, training group participants additionally completed a telephone interview.

The training group reported significantly higher levels of perceived usefulness, perceived ease of use, positive subjective norm, and intention to use the app (see Table 1). In addition, the training group (86%) reported a higher proportion of active app use than the non-training group (60%). TAM-based SMRA training was not viable in increasing the levels of medication adherence variables, attributable to ceiling effect (training group participants with relatively simple medication regimens might report moderate to high levels of medication adherence regardless of whether or not they received the training). Effect sizes for the TAM-based SMRA training suggested at least 52 participants as a sample size for a larger efficacy study.

Table 1
Differences in Outcome Variables Between Training Group and Non-Training Group

Variables	Training Group			Non-Training Group		
	IQR	<i>M (SD)</i>	<i>Mdn</i>	<i>M (SD)</i>	<i>Mdn</i>	<i>p</i>
Intention to use an SMRA	5.00-7.00	6.38 (0.70)	6.50	5.03 (1.75)	5.00	.04 ^a
Perceived usefulness	5.75-7.00	6.70 (0.46)	7.00	5.58 (1.21)	5.50	.003 ^a
Perceived ease of use	5.50-7.00	6.60 (0.65)	7.00	5.62 (1.28)	5.50	.02 ^a
Positive subjective norm	3.39-4.64	4.43 (0.71)	4.57	3.57 (1.31)	3.71	.04 ^b

Note. IQR = interquartile range.

^a*p* values calculated using Mann-Whitney *U* tests. ^b*p* values calculated using independent samples *t*-tests.

Participants suggested that training could be improved by:

- Scheduling separate group training for iPhone and Android phone users;
- Providing a live online training option as well as face-to-face training option;
- Providing group training with peer helper (participant with high level of tech-savviness) who can assist the participants who need additional help to learn about app use;
- Tailoring training length to participant preference;
- Providing SMRA training materials—such as an app training video or handout—in helping participants master app features at their own pace and through repetitive practice;
- Working with healthcare providers as co-trainers; and
- Working family members as co-trainees so that the family, as a support network, could work together in encouraging participants in medication adherence using the app.

The findings from this dissertation suggest the utility of TAM-based SMRA training as an intervention to help middle-aged to older adults with chronic conditions find the app to be useful and easy to use to support their medication adherence. As a practical implication, SMRA developers could use TAM-based SMRA training, perhaps as part of their app’s description page at App Store/Google Play, to promote app use and medication adherence among middle-aged to older adults with chronic conditions.

Published Work

Social/Behavioral

Factor Analysis of the Short Form Cohen Mansfield Agitation Inventory (CMAI) and the Measurement Invariance by Gender

Anju Paudel, PhD, MGS, RN, Barbara Resnick, PhD, CRNP, Elizabeth Galik, PhD, CRNP

Background: The Cohen-Mansfield Agitation Inventory (CMAI), available in both long and short versions, is a widely used measure to assess and evaluate agitation among older adults. There has been less psychometric testing of the short-form CMAI particularly with regard to the factor structure of this shorter measure.

Purpose: The purpose of this study was to test the internal consistency, reliability and validity of short-form CMAI in a sample of nursing home residents and examine if it is invariant across gender. Specifically, it was hypothesized that consistent with the long form CMAI, the short-form CMAI would have three factors with acceptable internal consistency and item reliability. In addition, it was hypothesized that there would be no difference in factor structure and factor means across gender.

Methods: This study utilized baseline data from a randomized trial including 553 residents from 55 nursing homes. Data was analyzed using structural equation modeling.

Results: Confirmatory factory analysis supported the three-factor structure of short-form CMAI (see Table 1) including *aggressive* ($\alpha= 0.794$), *physically non-aggressive* ($\alpha= 0.617$), and *verbally agitated* ($\alpha= 0.718$) behaviors; three items loading on *physically non-aggressive* behaviors had R^2 close to 0.3 suggesting low reliability (see Table 2). Invariance testing confirmed that the shortened measure is invariant across gender.

Conclusions: Short-form CMAI is a valid and reliable scale to assess agitation and gender differences in agitation in nursing home population. However, it could benefit from rewording the items with low reliability or, separating out individual behaviors in the single item. Future work could also consider a four-factor structure for this shortened measure and, assess the invariance of short-form CMAI by the level of cognitive impairment.

Keywords

Cohen-Mansfield, CMAI, agitation, nursing homes, factor analysis

Table 1. Model results of the three-factor solution of short-form CMAI with fit indices

Model	χ^2	df	CFI	TLI	RMSEA (90% CI)	SRMR
3-factor model	179.931*	74	0.933	0.917	0.052 (0.042, 0.061)	0.064

Note. N= 536. χ^2 = chi-square; * $p < 0.001$; df= degrees of freedom; CFI= Comparative Fix Index, TLI= Tucker-Lewis Index; RMSEA= Steigers Root Mean Square Error of Approximation; CI= Confidence Interval; SRMR= Standardized Root Mean Square Residual.

Table 2. *Three-factor CFA solution of short-form CMAI ($\alpha = 0.841$) with standardized factor loadings*

Factors	CMAI Items	Item Results			
		λ	SE	Z	R ²
Aggressive behavior ($\alpha = 0.794$)	1. Cursing or verbal aggression	0.813	0.028	29.40	0.661
	2. Hitting (including self), Kicking, Pushing, Biting, Scratching, Aggressive spitting (include at meals)	0.832	0.024	35.05	0.692
	3. Grabbing onto people, throwing things, tearing things or destroying property	0.918	0.029	31.58	0.842
	14. Screaming	0.786	0.038	20.64	0.617
Physically non-aggressive behavior ($\alpha = 0.617$)	4. Other aggressive behaviors or self-abuse including: Intentional falling, making verbal or physical sexual advances, Eating/drinking/chewing inappropriate substances, Hurts self or other with inappropriate substance	0.683	0.073	9.32	0.467
	5. Pace, aimless wandering, trying to get to a different place (e.g., out of the room/building)	0.569	0.047	12.13	0.324
	6. General restlessness, performing repetitious mannerisms, tapping, strange movements	0.823	0.040	20.48	0.678
	7. Inappropriate dress or disrobing	0.558	0.053	10.60	0.311
	8. Handling things inappropriately	0.749	0.063	12.04	0.562
	13. Hiding things, Hoarding things	0.503	0.087	5.81	0.253
	9. Constant request for attention or help	0.762	0.039	19.66	0.581
Verbally agitated behavior ($\alpha = 0.718$)	10. Repetitive sentences, calls, questions or words	0.788	0.043	18.24	0.620
	11. Complaining, Negativism, Refusal to follow directions	0.830	0.036	22.83	0.689
	12. Strange noises (weird laughter or crying)	0.674	0.067	10.02	0.455

Note. N=536; α = Cronbach's alpha; λ = standardized factor loadings; SE= standard error of the estimate; Z= λ /SE; R²= variance.

Work in Progress

Social/Behavioral

The Quality of Interactions Between Staff and Residents with Cognitive Impairment in Nursing Homes

Anju Paudel, PhDc, MGS, RN, Barbara Resnick, PhD, CRNP, Elizabeth Galik, PhD, CRNP

Background: Positive and effective staff–resident interactions are imperative to adequately assess and meet the needs of cognitively impaired residents in nursing homes and optimize their quality of life.

Purpose: The purpose of this study was to quantify, describe, and analyze the interaction between staff and cognitively impaired residents in nursing homes, using the Quality of Interaction Schedule (QuIS). Specifically, the following aims were addressed— *Aim 1:* To quantify and describe the quality of interactions between staff and cognitively impaired residents in nursing homes. *Aim 2:* To analyze whether the quality of staff–resident interactions vary by resident cognitive status (moderate vs severe) and interaction characteristics (interaction location, interaction situation, interpersonal distance, type of staff, and resident level of participation).

Method: This descriptive analysis utilized baseline data from the first 2 cohorts in a randomized clinical trial including 341 residents from 35 nursing homes.

Results: Five hundred fifty-six staff–resident interactions were evaluated; majority were positive ($n = 466$, 83.8%) and the remaining were either neutral ($n = 60$, 10.8%) or negative ($n = 30$, 5.4%). The quality of interactions varied by interaction location, interpersonal distance, and resident participation (see Table 1).

Conclusion: This study provides some current descriptive information about the quality of staff–resident interactions in nursing homes and the interaction characteristics that might impact these interactions. Future research should focus on decreasing the negative/neutral interactions and explore staff characteristics (e.g., gender, experience) and facility factors (e.g., size, ownership) that might influence the quality of interactions.

Keywords

staff–resident interactions, communication, cognitive impairment, long-term care, nursing homes

Table 1. *Adjusted Correlates of 'Positive' and 'Negative/neutral' Interactions*

Variables	Positive Interaction		Negative/neutral Interaction	
	Estimate (95% CI)	p-value	Estimate (95% CI)	p-value
Age	1.010 (0.978, 1.043)	0.54	0.993 (0.964, 1.023)	0.66
Gender, female (Ref= male)	1.547 (0.618, 3.871)	0.35	0.878 (0.415, 1.856)	0.73
Race, African American (Ref= Caucasian)	1.173 (0.375, 3.672)	0.78	0.436 (0.183, 1.036)	0.06
Marital status, married (Ref= not married)	1.410 (0.545, 3.648)	0.48	0.602 (0.271, 1.336)	0.21
Cognitive status, severe impairment (Ref= moderate impairment)	0.699 (0.250, 1.957)	0.50	0.956 (0.408, 2.240)	0.92
Interaction location, private area (Ref= not private)	0.137 (0.044, 0.431)	<0.01	4.521 (1.862, 10.981)	<0.01
Interaction situation, care related (Ref= not care-related)	1.002 (0.373, 2.698)	0.99	1.339 (0.583, 3.076)	0.50
Interpersonal distance, <30 inches (Ref= >30 inches)	0.340 (0.151, 0.762)	<0.01	1.483 (0.745, 2.952)	0.26
Type of staff/ person resident interacting with, nursing (Ref= not nursing)	2.093 (0.771, 5.681)	0.15	0.507 (0.217, 1.186)	0.12
Resident participation, active (Ref=passive)	0.052 (0.022, .123)	<.0001	9.663 (4.555, 20.499)	<.0001

Abbreviation: CI=Confidence Interval.

Note. N=303; Covariates: Age, gender, race, and marital status; Predictors: cognitive status, interaction location, interaction situation, interpersonal distance, type of staff, and resident participation. Of covariates, race and marital status were associated with 'positive' interaction while only marital status was associated with 'negative/neutral' interaction in the bivariate model. While these covariates lost their significance in the multivariable model, the predictors that were significant in bivariate model retained their significance in multivariable model except interpersonal distance which lost the significance in the multivariable model for 'negative/neutral' interactions.

Published Work

Social/Behavioral

Association between Adverse Consequences of Unmet In-Home Mobility Care Needs and Risk of Hospital Stay among Older Adults in the U.S

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Abstract Text:

Mobility limitations are the most prevalent late life disability and are strongly associated with negative health outcomes. Research suggests that about 1 in 5 older adults with limitations in activities of daily living report needing more help than is received. There is insufficient research examining how adverse consequences of unmet in-home mobility care needs relate to hospital stay among community-dwelling older adults in the U.S. This study addresses a gap in the literature by directly examining the relationship between unmet in-home mobility care needs and hospital stay for a national sample of older adults. Data was analyzed from round eight (2018) of the National Health and Aging Trends Study (NHATS), an epidemiologic panel study of nationally representative Medicare beneficiaries ages 65 and older living in the communities (n = 4,344). The final analytic sample included respondents with valid data on all variables (n = 4,241). Community dwelling adults with one or more adverse consequence due to in-home mobility limitation had 1.931 times odds of hospital stay in the last 12 months, compared to the counterpart with no in-home mobility limitation (OR = 1.931, SE = 0.153, p < 0.05), after adjusting for the covariates. Community-dwelling older adults who have adverse consequence due to unmet in-home mobility care needs are more likely to be immobile and are more likely to have hospital stays. Late life dependency has become a major public concern due to the reduced availability of family caregivers and uncertainty about future disability trends among older adults. By addressing the needs of this population, the rate of hospitalization can be decreased resulting in fewer stressful events and better quality of life. Policies to improve long-term services and supports and reduce unmet need could benefit both older adults and those who care for them.

Work in Progress

Social/Behavioral

Shining Light and Creating Solutions: Health and Social Needs of Older Affordable Housing Residents

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Aging within a community requires access to health and social services. This project lays the groundwork for an innovative, three-part health and social services intervention intended to improve the health and well-being of older affordable housing residents in a low-income, vulnerable Baltimore neighborhood. Part 1 is an assessment of residents' unmet health and social service needs and their ideas for meeting these needs. With guidance from a community advisory group of older residents (a key program component), we will conduct structured interviews with 50 elders to identify residents' needs and interests. These findings will inform the next project segments: Part 2 will explore how the Village model (in which neighbors identify and offer needed services to help their neighbors age within a community) can be adapted for an affordable housing setting. Part 3 will adapt an evidence-based housing-plus-services model to meet older residents' unmet needs and examine its impact.

Work in Progress

Social/Behavioral

Older Adults' Self-Reported Quality of Life: The Role of Food and Social Contacts

Anna Vaudin, MS

As people get older, there is an increased need for services that can help them maintain their health and quality of life in their own homes. The Older Americans Act Nutrition Programs aim to promote health and well-being of older individuals by reducing hunger and food insecurity, promoting socialization, and delaying the onset of adverse health conditions. Research is limited, however, on what older adults consider to be the main contributors to their quality of life. This study investigated how older adults describe their quality of life, and the impact that loneliness, food, and eating may have on it. Thirty (30) community-dwelling older adults completed in-person qualitative interviews. A grounded theory approach was used to assign codes to the participants' responses and identify themes in the data. Independence, mobility, and health were consistently reported as the main contributors to quality of life, even when limited. Some participants reported that social contacts contributed to quality of life and loneliness detracted from it, while others reported that they preferred being alone. Participants responded that food contributes to quality of life when they have control over what they eat and are able to eat food that makes them feel good. Community programs that contribute to older adults' independence and mobility are essential for helping them maintain their quality of life. Additionally, an individual's feelings and needs with regards to socialization may affect service usage, suggesting that programs may appeal to more people if they offer services with a range of social contact.

Work in Progress

Social/Behavioral

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