BIOGRAPHICAL SKETCH

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NAME: VILLAPOL, SONIA

eRA COMMONS USER NAME (credential, e.g., agency login): SVILLAPOL

POSITION TITLE: Assistant Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, including postdoctoral training and residency training if applicable. Add/delete rows as necessary.):*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Santiago of Compostela, Spain	BSc	02/2003	Molecular Biology
Autonomous University of Barcelona, Spain	MS	10/2004	Neuroscience
Autonomous University of Barcelona, Spain	PhD	10/2007	Neuroscience
Pierre-Marie Curie Université, France	Postdoctoral	10/2008	Neuroscience
French National Inst. of Health, France	Postdoctoral	06/2010	Neuroscience
National Institutes of Health, MD, USA	Postdoctoral	10/2013	Pharmacology
Uniformed Services University, MD, USA	Postdoctoral	04/2014	Neuroscience

A. Personal Statement

Throughout my career, I have focused on understanding and mitigating neuroinflammation following neurotrauma and neurodegenerative conditions, with a particular emphasis on the interplay between peripheral systems and brain pathology. My research has contributed to identifying novel therapeutic strategies and addressing limitations in current treatments for brain injuries through nanomedicine, targeted drug delivery, and gut microbiota modulation. My lab has extensively studied the neuropathological consequences of brain damage, investigating neuroinflammatory, neurodegenerative, and apoptotic pathways in various preclinical models.
Since joining the Houston Methodist Research Institute (HMRI) seven years ago, I have successfully led multiple research projects as Principal Investigator (PI), securing competitive funding from prestigious agencies, including DoD-DARPA ($350K), R21 NS106640 (NIH/NINDS, $440K), R21 NS127265 (NIH/NINDS, $444K), Mission Connect (TIRR Foundation, $100K), and R56 AG080920 (NIH/NIA, $1.25M). Additionally, I have contributed as a Co-Investigator on projects funded by HMRI, the Alzheimer's Association, and other foundations.

With 78 peer-reviewed publications (h-index: 37) and book chapters, my research spans preclinical and clinical studies, focusing on neurodegeneration, inflammation, and the brain-gut axis. My team investigates the inflammatory response and its role in disease progression in Alzheimer's disease (AD) and traumatic brain injury (TBI), employing advanced methodologies such as snRNA sequencing, metabolomics, metagenomics sequencing, immunohistochemistry, RNAscope, multi-omics approaches, neuroimaging, and functional behavioral testing in AD/TBI mouse models.

Beyond research, I am dedicated to mentorship and education. I have mentored over 70 trainees, including undergraduate and medical students, Ph.D. and master's students, postdoctoral fellows, medical residents, and junior faculty. They have consistently relied on my support through letters of recommendation and career guidance. Many of my master's and undergraduate trainees have successfully gained admission to medical school, with their experience in my lab playing a pivotal role. Postdoctoral fellows have advanced in their academic careers, securing positions as Assistant Professors or roles in government, while a smaller percentage have transitioned into industry. Over 30 researchers have trained in my lab at HMRI, where I currently oversee two postdoctoral fellows, two research assistants, and two Ph.D. students from the Weill Cornell-Methodist program. My teaching experience includes serving as an instructor in the Medical School and the Master's Program in Integrative Neuroscience and Pharmacology, as well as four years at Georgetown University Medical School. At HMRI, I contribute to the Neural Injury and Activity in Motor and Peripheral Organ Plasticity program and Weill Cornell-Methodist Ph.D. Program. Mentorship has been one of the most fulfilling aspects of my career.

In 2018, I was honored with the Faculty Award for Excellence in Mentorship in the M.S. Biochemistry and Molecular Biology program at Georgetown University. Through research, teaching, and mentorship, I have built a multidisciplinary program at the Center for Neuroregeneration, bridging basic and translational neuroscience with a strong focus on therapeutic innovation for neurodegenerative diseases and brain injuries.

Ongoing projects that I would like to highlight include:

- **R56AG080920 (NIH/NIA)** (PI: **Villapol**) 11/2023 – 06/2026. "*Microbiota-targeted approaches to resolve dysbiosis-induced AD neuropathology following brain injury".* We will characterize the impact of antibiotics (ABX) on AD pathology after TBI and further explore how restoring the AD gut microbiome using fecal microbiota transplants (FMT) after TBI can reduce the inflammatory response and Aβ accumulation in the brain and modulate motor deficits and cognition. *Total:* $1,284,000
- **Alzheimer's Association Research Grant** to Promote Diversity-New to the Field (PI: Blanco, Co-I: **Villapol**) 02/2022 – 01/2026. "*Mitochondrial replenishment as a therapy in Alzheimer's disease".* This grant aims to deliver polymer-functionalized mitochondria to neurons to restore favourable metabolic phenotypes and mitochondrial function that can attenuate AD progression. *Total:* $150,000
- **NFL Players Association - SAB RFI (NFLA)** (PI: **Villapol**) 05/2024 – 04/2026. *"Gut microbiome markers of sport-related brain concussion".* The gut microbiome will be analyzed as a potential biomarker profile to diagnose concussions in contact sports athletes and to investigate its association with inflammatory markers in the blood. Collaboration with Rice University. *Total:* $443,402.

Below are the last recent publications that highlight this experience:

1. Soriano S, Curry K, Sadrameli SS, Wang Q, Nute M, Reeves E, Kabir R, Wiese J, Criswell A, Schodrof S, Britz GW, Gadhia R, Podell K, Treangen T, **Villapol S**. Alterations to the gut microbiome after sport-related concussion in a collegiate football players cohort: A pilot study. **Brain Behav Immun Health**. 2022 May;21:100438. doi: 10.1016/j.bbih.2022.100438. 2022 May. PMID: 35284846; PMCID: PMC8914332.
2. Baudo G, Flinn H, Holcomb M, Tiwari A, Soriano S, Taraballi F, Godin B, Zinger A, **Villapol S.** Sex-dependent improvement in traumatic brain injury outcomes after liposomal delivery of dexamethasone in mice. **Bioengineering & Translational Medicine**. 2024; 9(4):e10647. doi:10.1002/btm2.10647
3. Scalzo PL, Marshall AG, Soriano S, Curry K, Dulay M, Hodics T, Quigley EMM, Treangen TJ, Piskorz MM, **Villapol S**. Gut Microbiome dysbiosis and immune activation correlate with somatic and neuropsychiatric symptoms in COVID-19 patients. **J Transl Med**. 2025 Mar 14;23(1):327. doi: 10.1186/s12967-025-06348-y. PMID: 40087795.
4. Flinn H, Marshall A, Holcomb M, Cruz L, Soriano S, Treangen TJ, **Villapol S.** Antibiotic treatment induces microbiome dysbiosis and reduction of neuroinflammation following traumatic brain injury in mice. Res Sq 2024 Jun 11:rs.3.rs-4475195. doi: 10.21203/rs.3.rs-4475195/v1. PMID: 38946944; PMCID: PMC11213166. **Cell Reports***, in press.*

B. Positions, Scientific Appointments, and Honors

Positions and Scientific Appointments

2025 –	Faculty, Houston Methodist Neurological Institute (HMNI). Houston Methodist Hospital.
2024 –	Faculty, Houston Methodist Lynda K. and David M. Underwood Center for Digestive Disorders, HMRI, Houston, TX.
2020 –	Faculty Academic Visitor, Rice University, Houston, TX
2019 –	Assistant Professor of Neuroscience in Neurological Surgery, Weill Cornell Medical College, NY
2019 –	Adjunct Professor of Neuroscience, College of Medicine, Texas A&M, Houston, TX
2019 –	Faculty Academic Visitor, Baylor College of Medicine, Houston, TX
2018 –	*Assistant Professor of Neurosurgery, Houston Methodist Research Institute, Houston, TX*
2014 – 2018	Research Assistant Professor of Neuroscience, Georgetown University, Washington, D.C.
2010 – 2014	Postdoctoral Fellow, Center for Neuroscience and Regenerative Medicine, Bethesda, MD
2010 – 2013	Postdoctoral Fellow, National Institutes of Mental Health, Bethesda, MD
2009 – 2010	Postdoctoral Fellow, French National Institute of Health & Medical Research, Paris, France
2007 – 2009	Postdoctoral Fellow, Centre National de la Recherche Scientifique, Paris, France
2007	Associate Lecturer, Autonomous University of Barcelona, Barcelona, Spain
2003 – 2007	Predoctoral Fellow, Autonomous University of Barcelona, Barcelona, Spain
1997 – 2003	Undergraduate Research Assistant, University of Santiago de Compostela, Santiago, Spain

Grant Reviewer service: Grant Reviewer (*Ad hoc*), NIH U19. Alzheimer's Microbiome (U19) Special Emphasis Panel (2024). New Jersey Commission on "Brain Injury Research Independent Scientific Merit" (*Ad hoc*) (2019, 2021, 2022, 2023, 2024, 2025); NIH Study Section "Molecular Neurogenetics (MNG)" panel, (*Ad hoc* and *Standing member) (2019, 2020, 2021,* 2022, 2023, 2024); VA RR&D Scientific Merit Review Subcommittee on Chronic Medical Conditions and Aging (RRD6) (*Ad hoc*) (2024);Traumatic Brain Injury – Post-Traumatic Stress Disorder (TBI-PTSD) peer review panel of the TBI and Psychological Health Research Program (TBIPHRP) (*Ad hoc*) (2021, 2022, 2023); Spanish State Agency for Research (AEI)", Spain (*Ad hoc*) (2018, 2021, 2020); MRMC Broad Agency Announcement for Extramural Medical Research on the Combat Casualty Care (CCC) for the Department of Defense Congressionally Directed Medical Research Programs (CDMRP), (*Ad hoc*) (2019, 2022); NIH Study Section Center for Scientific Review Emphasis Panel "Acute Brain Injury" (*Ad hoc*) (2019); NIH, Study Section "Acute Neural Injury and Epilepsy (ANIE)" panel, (*Ad hoc*) (2018); "I+D Project-2018, CSIC", Universidad de la República, Uruguay, External Grant Reviewer, (*Ad hoc*) (2018); 25th TV3 Marató on "Strokes and traumatic spinal cord and brain injury", Barcelona (Spain) External Reviewer, (*Ad hoc*) (2017); "Israel Science Foundation" (ISF), Israel, External Reviewer, (*Ad hoc*) (2017).

Reviewer for Journals (selected)**:** (Gut Microbes, Brain, Molecular Biology, Molecular Neurodegeneration, Journal of Neuroinflammation, Cellular and Molecular Neurobiology, BMC Neuroscience, Frontiers in Neurotrauma, Frontiers in Immunology, Frontiers in Neuroscience, Frontiers in Neurology, Experimental Neurology, Journal of Neurochemistry, Brain Research, Neurochemical Research, PloS One, Peer J, American Journal of Pathology, Molecular Neurobiology, Neural Regeneration Research, Disease Models and Mechanisms, Experimental Brain Research, BMC Pediatrics, Neuroscience Research, Behavioral Brain Immunity, Frontiers in Aging Neuroscience, Journal of Neurotrauma, and Nature Communications).

Honors

2024	Associate Editor: Gut Microbes. *Taylor & Francis*.
2024	Recognition of *"Biologist of the Year"* by the Official College of Biologists of Galicia, Spain
2023	NIH Competitiveness Award Initiative ($50,000), Houston, TX.
2022 –	Mental Health Steering Committee member representing HMRI at Gulf Coast Consortia, TX.
2022 –	Western Neurotrauma Faculty Award, UCLA, Los Angeles, CA.
2021 –	President's Award for Excellence in Peer-Reviewed Publication, HMRI, Houston, TX.
2021 –	Associate Editor in Neurotrauma: Frontiers of Neurology.
2021 – 2024	Finalist *"Top 10 Women Leaders Aboard".* Mujeres&Co, Spain.
2020 – 2024	Standing member at NIH Study Section Molecular Neurogenetics (MNG).
2019 – 2023	President, Spanish scientists in the USA, Texas Chapter (ECUSA).
2019	Institute of Biosciences and Bioengineering (IBB) Hamill Innovation Award ($25,000), TX.
2018	Faculty Award for Excellence in Mentorship in the Master Biochemistry and Molecular Biology Program, Georgetown University, Washington, D.C.
2018 – 2023	Associate Editor: Cellular and Molecular Neurobiology (CEMN), Springer.
2013	1st Place Poster Award, National Capital Area TBI Research Symposium, Bethesda, MD.
2013	1st Place for Young Scientist Career Trajectory Award, Foundation Barrié, A Coruña, Spain.
2012	Superior Performance Award as Postdoctoral Fellow, Henry Jackson Foundation, Bethesda, MD.
2011 – 2013	Fellowship Award, Henry M. Jackson Foundation, Bethesda, MD.
2009 – 2010	Postdoctoral Fellowship Award, PremUp, Paris, France.
2008 – 2009	Mairie Paris Postdoctoral Fellowship Award, Mairie Paris City Hall, Paris, France.
2008 – 2009	Mairie Paris Postdoctoral Fellowship Award, Mairie Paris City Hall, Paris, France.
2008 –	Member of the Society for Neuroscience and Member of National Neurotrauma Society.
2007	Extraordinary Doctorate Award *Summa Cum Laude*, Autonomous University of Barcelona, Barcelona, Spain.

C. Contributions to Science

1. **Neuroinflammation and therapeutic approaches for neonatal damaged brain.** During my graduate studies, I explored the mechanisms of neuroinflammation and neuronal death in an excitotoxicity model by

injecting NMDA into the neonatal brain (a). These studies helped to understand the differential mechanisms between neonates' and adults' brains and established the basis for sex-differentiated responses to brain injury. In addition, the apoptotic and neurodegenerative pathways were characterized in the neonatal brain at different times after the injury (b, c), which is critical for applying new treatments. Studying the mechanisms of brain damage, I developed a broad skill set and solid foundation that enabled me to launch my independent research career. During my first postdoctoral training, I helped characterize and understand a preclinical model of cerebral ischemia. Further, I demonstrated different therapies, such as melatonin treatment (d), in a neonatal stroke model.

a. **Villapol S**, Acarin L, Faiz M, Castellano B, Gonzalez B. Survivin and heat shock protein 25/27 colocalize with cleaved caspase-3 in surviving reactive astrocytes following excitotoxicity to the immature brain. **Neuroscience.** 2008 Apr;153(1):108-19. PMID: 18358624
b. **Villapol S**, Gelot A, Renolleau S, Charriaut-Marlangue C. Astrocyte responses after neonatal ischemia: the yin and the yang. **Neuroscientist.** 2008 Aug;14(4):339-44. PMID: 18612085
c. **Villapol S**, Bonnin P, Fau S, Baud O, Renolleau S, Charriaut-Marlangue C. Unilateral blood flow decrease induces bilateral and symmetric responses in the immature brain. **Am J Pathol.** 2009 Nov;175(5):2111-20. PMID: 19815715; PMCID: PMC2774074
d. **Villapol S**, Fau S, Renolleau S, Biran V, Charriaut-Marlangue C, Baud O. Melatonin promotes myelination by decreasing white matter inflammation after neonatal stroke. **Pediatr Res.** 2011 Jan;69(1):51-5. PMID: 20856166

2. **Neurorestoration after TBI through angiotensin II receptor inhibition.** As a postdoctoral fellow, I continued to investigate the mechanisms of neuroinflammation, enabling me to develop therapeutic strategies for brain damage, specifically brain trauma (a, b). We found that angiotensin receptor blocker treatment in a mouse model of TBI reduced brain injury and improved cognitive and motor behaviors after TBI (c). Angiotensin II Receptor Blockers (ARBs) are FDA-approved drugs with regulated safety, and they hold great therapeutic potential in the protection and restoration of brain damage. In addition, I discovered how, after TBI, the liver releases a small protein (serum amyloid A, SAA) that regulates inflammation in the brain (d). Our findings revealed that inhibiting liver inflammation alleviates brain damage.
   a. **Villapol S**, Yaszemski AK, Logan TT, Sánchez-Lemus E, Saavedra JM, Symes AJ. Candesartan, an angiotensin II AT_1-receptor blocker and PPAR-γ agonist, reduces lesion volume and improves motor and memory function after traumatic brain injury in mice. **Neuropsychopharmacology**. 2012 Dec;37(13):2817-29. PMID: 22892395; PMCID: PMC3499714
   b. **Villapol S**, Byrnes KR, Symes AJ. Temporal dynamics of cerebral blood flow, cortical damage, apoptosis, astrocyte-vasculature interaction, and astrogliosis in the pericontusional region after traumatic brain injury. **Front Neurol.** 2014 Jun;5:82. PMID: 24926283; PMCID: PMC4044679
   c. **Villapol S**, Balarezo MG, Affram K, Saavedra JM, Symes AJ. Neurorestoration after traumatic brain injury through angiotensin II receptor blockage. **Brain**. 2015 Nov;138(Pt 11):3299-315. PMID: 26115674; PMCID: PMC4731413
   d. **Villapol S**, Kryndushkin D, Balarezo MG, Campbell AM, Saavedra JM, Shewmaker FP, Symes AJ. Hepatic expression of serum amyloid A1 is induced by traumatic brain injury and modulated by telmisartan. **Am J Pathol.** 2015 Oct;185(10):2641-52. PMID: 26435412; PMCID: PMC4607758

3. **Neuro-long COVID-19, biomarkers and gut microbiome.** Since the onset of the COVID-19 pandemic, my lab has focused on understanding the gut microbiome's role in acute and long-term COVID-19. After uncovering how gastrointestinal changes (a) and microbiome composition influence disease progression, we launched a clinical trial to assess the benefits of prebiotics and tannins in COVID-19 patients (b). Our work contributed to a high-impact meta-analysis (99th percentile, 9300 impact metrics) identifying long-term COVID-19 as a severe chronic condition (c), and to an international consensus on addressing COVID-19 as an ongoing global health threat (d). We remain committed to developing new diagnostics and treatments for Long COVID.
   a. **Villapol S.** Gastrointestinal symptoms associated with COVID-19: impact on the gut microbiome. **Transl Res.** 2020 Dec; 226:57-69. PMID: 32827705
   b. Scalzo PL, Marshall AG, Soriano S, Curry K, Dulay M, Hodics T, Quigley EMM, Treangen TJ, Piskorz MM, **Villapol S**. Gut Microbiome dysbiosis and immune activation correlate with somatic and neuropsychiatric symptoms in COVID-19 patients. **J Transl Med.** 2025 Mar 14;23(1):327. doi: 10.1186/s12967-025-06348-y. PubMed PMID: 40087795.

c. Lopez-Leon S, Wegman-Ostrosky T, Perelman C, Sepulveda R, Rebolledo PA, Cuapio A, **Villapol S.** More than 50 long-term effects of COVID-19: a systematic review and meta-analysis. **Sci Rep.** 2021 Aug; 11(1):16144. PMID: 34373540
d. Lazarus J,….**Villapol S**, Yap P, Binagwaho A, Kamarulzaman A, El-Mohandes. A multinational Delphi consensus to end the COVID-19 public health threat. **Nature**. 2022 Nov 3. doi: 10.1038/s41586-022-05398-2. PMID: 36329272.

4. **Drug delivery using nanoparticles for TBI.** Nanoparticles (NPs) have been used in multiple diseases as drug delivery tools with remarkable success due to their rapid diffusion and specificity in the target organ. We fabricated leukocyte-based biomimetic NPs as a theranostic tool to access inflamed brain regions directly in a TBI mouse model (a). Our results suggest lipid NPs are highly effective and should be considered a potential candidate for brain injury therapies. This work lays the foundation for developing a transformational therapeutic approach to resolve neuroinflammation (b, c, d) in AD and TBI patients.
   a. Zinger A, Soriano S, Baudo G, De Rosa E, Taraballi F, **Villapol S**. Biomimetic Nanoparticles as a theranostic tool for traumatic brain injury. **Adv Funct Mater**. 2021 Jul 23;31(30):2100722. PMID: 34413716.
   b. **Villapol S**, Loane DJ, Burns MP. Sexual dimorphism in the inflammatory response to traumatic brain injury. **Glia**. 2017 Sep;65(9):1423-1438. PMID: 28608978
   c. Baudo G, Flinn H, Holcomb M, Tiwari A, Soriano S, Taraballi F, Godin B, Zinger A, **Villapol S.** Sex-dependent improvement in traumatic brain injury outcomes after liposomal delivery of dexamethasone in mice. **Bioengineering & Translational Medicine**. 2024; 9(4):e10647. doi:10.1002/btm2.10647
   d. Lopez-Espinosa J, Park P, Holcomb M, Godin B, **Villapol S**. Nanotechnology-driven therapies for neurodegenerative diseases: a comprehensive review. **Ther Deliv.** 2024;15(12):997-1024.

5. **Brain-gut-microbiome alterations in TBI and AD animal models.** My research has shifted towards examining how TBI impacts peripheral organ functionality and studying the changes in the microbiome following neurodegeneration. We recognize gut microbiota as a critical neuromodulator in gut-brain axis communication, significantly affecting brain inflammation and recovery using mouse TBI (a) and AD models. Our approaches to modifying the gut microbiota, including probiotics (b) and fecal microbiota transplants, have shown promising results in neurorestoration mechanisms. These therapeutic investigations were evaluated functionally through various tests, including assessments of motor skills, memory, and cognitive functions, and evaluations of anxiety and depressive behaviors. We have pinpointed microbiome biomarkers that could allow us to track the progression of concussions over time and pave the way for innovative treatments to mitigate concussion effects (c). Additionally, our lab has developed and made available a software tool, EMU, for bacterial species identification using Nanopore technology (d).
   a. Treangen TJ, Wagner J, Burns MP, **Villapol S**. Traumatic brain injury in mice induces acute bacterial dysbiosis within the fecal microbiome. **Front Immunol.** 2018 Nov; 9:2757. PMID: 30546361; PMCID: PMC6278748.
   b. Holcomb M, Marshall A, Flinn H, Lozano M, Soriano S, Gomez-Pinilla F, Treangen T, **Villapol S**. Probiotic treatment causes sex-specific neuroprotection after traumatic brain injury in mice; doi: 10.1101/2024.04.01.587652. ***Journal of Neuroinflammation**, 2025 Apr 20;22(1):114.*
   c. Curry K, Wu Q, Nute M, Tyshaieva A, Reeves E, Soriano S, Wu Q, Graeber E, Finzer P, Mendling W, Savidge T, **Villapol S**, Dilthey A, Treangen T. Emu: species-level microbial community profiling of full-length 16S rRNA Oxford Nanopore sequencing data. **Nat Methods**. 2022 Jul;19(7):845-853. doi: 10.1038/s41592-022-01520-4. PMID: 35773532.
   d. Flinn H, Marshall A, Holcomb M, Cruz L, Soriano S, Treangen TJ, Villapol S. Antibiotic treatment induces microbiome dysbiosis and reduction of neuroinflammation following traumatic brain injury in mice. Res Sq [Preprint]. 2024 Jun 11:rs.3.rs-4475195. doi: 10.21203/rs.3.rs-4475195/v1. PMID: 38946944; PMCID: PMC11213166. **Cell Reports**, *In press.*

Complete List of Published Work in My Bibliography (**78 peer-reviewed publications**, **h-index 37**): https://www.ncbi.nlm.nih.gov/myncbi/sonia.villapol.3/bibliography/56366772/public/