

# Sebastian Brandhorst, PhD

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## Professional Experience and Education

- 07.2023 - *current*      **Research Assistant Professor**; Longevity Institute, School of Gerontology, and Department of Biological Sciences, University of Southern California, Los Angeles, CA 90089, USA
- 09.2018 – 06.2023      **Research Assistant Professor**; School of Gerontology, University of Southern California, Los Angeles, CA 90089, USA
- 01.2019 - 12.2020      **Medical Director**; Create Cures Foundation, Los Angeles, CA, USA
- 10.2012 - 11.2018      **Consultant**; L-Nutra Inc., Culver City, CA 90232, USA.
- 03.2015 -11.2018      **Laboratory supervisor**; Longevity Institute, School of Gerontology, University of Southern California, Los Angeles, CA 90089, USA
- 10.2012 - 03.2015      **Laboratory technician** for Prof. Dr. Valter Longo at the Longevity Institute, School of Gerontology, and Department of Biological Sciences, University of Southern California, Los Angeles, CA 90089, USA
- 03.2010 - 03.26.2013      **Doctorate Degree** from the University of Duisburg-Essen (Germany);  
**Visiting scholar** at the University of Southern California (USA)  
Thesis title *"Dietary- and Fasting-based Interventions to Improve the Efficacy of Cancer Treatment"*
- 03.2009 - 09.2009      **Master-Thesis**, laboratory of Dr. Jakob at the University of Michigan, Ann Arbor, Michigan, USA  
Thesis Title *"The role of the Thioredoxin reductase system in maintaining the yeast redox-balance and its implication in chronological aging"*
- 09.2008 - 03.2009      **Internship** in the Laboratory of Dr. Ursula Jakob  
University of Michigan, Ann Arbor, Michigan, USA
- 09.2007 - 09.2009      **Medical-Biology (M.Sc.)**  
University of Duisburg-Essen, Germany
- 03.2007 - 09.2007      **Bachelor-Thesis** at the Department for Developmental Biology, Centre for Medical Biotechnology, University Duisburg-Essen, Germany  
Thesis title: *"Establishment of an in vitro model for the analysis of chondrocyte-specific gene expression in the ATDC5-cell line"*
- 09.2004 – 09.2007      **Medical-Biology (B.Sc.)**  
University of Duisburg-Essen, Germany
- 2003 – 2004      **Social service**  
SOS Pflegedienst Essen, Germany
- 1994 – 2003      **Abitur**  
Helmholtz-Gymnasium, Essen, Germany

## Awards and Honors

01.15.2020	<b>2019 AARP Best Research Scientist Award</b>
06.04.2019	<b>Butler-William Scholar</b> , National Institute on Aging
12.31.2017	<b>Irene Diamond Fund/AFAR Postdoctoral Transition Award in Aging</b>
05.03.2017	<b>Stevens Center for Innovation Commercialization Award</b>
10.19.2016	<b>Dean's Research Staff Award 2016</b>
05.17.2013	<b>Heinz H. Osterburg Prize for Predoctoral Research in Gerontology</b>

## Memberships

January 2017	<b>Growth Research Society</b>
March 2017	<b>The National Academy of Inventors</b>
April 2018	<b>The Gerontological Society of America</b>
January 2019	<b>American College of Nutrition</b>

## Peer-reviewed Original Research Publications

### **Fasting-mimicking diet causes hepatic and blood markers changes indicating reduced biological age and disease risk.**

#[Sebastian Brandhorst](#), #Morgan E. Levine, Min Wei, Mahshid Shelehchi, Todd E. Morgan, Krishna S. Nayak, Tanya Dorff, Kurt Hong, Eileen M. Crimmins, Pinchas Cohen, Valter D. Longo  
Nat Commun. 2024; **accepted for publication**  
*#Both authors contributed equally to this publication.*

### **Fasting mimicking diet cycles versus a Mediterranean diet and cardiometabolic risk in overweight and obese hypertensive subjects: a randomized clinical trial.**

Amrendra Mishra, Maura Fanti, Xinzhou Ge, Don Vaughn, [Sebastian Brandhorst](#), Min Wei, Kurt M. Hong, Matteo Pellegrini, Hanno Pijl, Mark C. Houston & Valter D. Longo  
npj Metabolic Health and Disease (2023) 1:1; <https://doi.org/10.1038/s44324-023-00002-1>

### **Diet composition influences the metabolic benefits of short cycles of very low caloric intake.**

Diaz-Ruiz A, Rhinesmith T, Pomatto-Watson LCD, Price NL, Eshaghi F, Ehrlich MR, Moats JM, Carpenter M, Rudderow A, [Brandhorst S](#), Mattison JA, Aon MA, Bernier M, Longo VD, de Cabo R.  
Nat Commun. 2021 Nov 9;12(1):6463. PMID: 34753921

### **Fasting-mimicking diet prevents high-fat diet effect on cardiometabolic risk and lifespan.**

Mishra A, Mirzaei H, Guidi N, Vinciguerra M, Mouton A, Linaudic M, Rappa F, Barone R, Navarrete G, Wei M, [Brandhorst S](#), Di Biase S, Morgan TE, Ram Kumar S, Conti PS, Pellegrini M, Bernier M, de Cabo R, Longo VD.  
Nat Metab. 2021 Oct;3(10):1342-1356. PMID: 34650272

### **Fasting-mimicking diet and hormone therapy induce breast cancer regression.**

Caffa I, Spagnolo V, Vernieri C, Valdemarin F, Becherini P, Wei M, [Brandhorst S](#), Zucal C, Driehuis E, Ferrando L, Piacente F, Tagliafico A, Cilli M, Mastracci L, Vellone VG, Piazza S, Cremonini AL, Gradaschi R, Mantero C, Passalacqua M, Ballestrero A, Zoppoli G, Cea M, Arrighi A, Odetti P,

Monacelli F, Salvadori G, Cortellino S, Clevers H, De Braud F, Sukkar SG, Provenzani A, Longo VD, Nencioni A.  
Nature. 2020 Jul;583(7817):620-624. PMID: 32669709

**The mitochondrial derived peptide humanin is a regulator of lifespan and healthspan.**

Yen K, Mehta HH, Kim SJ, Lue Y, Hoang J, Guerrero N, Port J, Bi Q, Navarrete G, [Brandhorst S](#), Lewis KN, Wan J, Swerdloff R, Mattison JA, Buffenstein R, Breton CV, Wang C, Longo V, Atzmon G, Wallace D, Barzilai N, Cohen P.  
Aging (Albany NY). 2020 Jun 23;12(12):11185-11199. PMID: 32575074

**Assessing Insulin and Glucose Tolerance in the Aging Mouse.**

Buono R, [Brandhorst S](#).  
Methods Mol Biol. 2020;2144:125-129. PMID: 32410030

**Synergistic effect of fasting-mimicking diet and vitamin C against KRAS mutated cancers.**

Di Tano M, Raucci F, Vernieri C, Caffa I, Buono R, Fanti M, [Brandhorst S](#), Curigliano G, Nencioni A, de Braud F, Longo VD.  
Nat Commun. 2020 May 11;11(1):2332. PMID: 32393788

**Fasting-Mimicking Diet Modulates Microbiota and Promotes Intestinal Regeneration to Reduce Inflammatory Bowel Disease Pathology.**

Rangan P, Choi IY, Navarrete G, Guen E, [Brandhorst S](#), Enyati N, Pasia G, Wei M, Longo VD.  
Cell Reports 26, 2704–2719, March 5, 2019. PMID: 30840892

**Humanin Prevents Age-Related Cognitive Decline in Mice and is Associated with Improved Cognitive Age in Humans.**

Yen K, Wan J, Mehta HH, Miller B, Christensen A, Levine ME, Salomon MP, [Brandhorst S](#), Xiao J, Kim SJ, Navarrete G, Campo D, Harry GJ, Longo V, Pike CJ, Mack WJ, Hodis HN, Crimmins EM, Cohen P.  
Sci Rep. 2018 Sep 21;8(1):14212. PMID: 30242290

**Chronic Treatment With the Mitochondrial Peptide Humanin Prevents Age-related Myocardial Fibrosis in mice.**

Qin Q, Mehta H, Yen K, Navarrete G, [Brandhorst S](#), Wan J, Delrio S, Lerman LO, Cohen P, Lerman A.  
Am J Physiol Heart Circ Physiol. 2018 Jul 13. PMID: 30004252

**Fasting and Metformin Regulate EGR1 to Protect from Dexamethasone and Glucose - Dependent Sensitization.**

Di Biase S, Shim HS, Kim KH, Vinciguerra M, Rappa F, Wei M, [Brandhorst S](#), Cappello F, Mirzaei H, Lee C, Longo VD.  
PLOS Biology. 2017 Mar 30;15(3):e2001951. PMID: 28358805

**Fasting-Mimicking Diet and Risk Factors for Aging, Diabetes, Cancer and Cardiovascular Disease.**

Wei M<sup>#</sup>, [Brandhorst S](#)<sup>#</sup>, Shelehchi M, Mirzaei H, Cheng CW, Budniak J, Groshen S, Mack WL, Guen E, Di Biase S, Cohen P, Morgan TE, Dorff T, Hong K, Michalsen A, Laviano A, Longo VL.  
Sci Transl Med. 2017 Feb 15;9(377). PMID: 28202779

#Both authors contributed equally to this publication.

**Effects of Prolonged GRP78 Haploinsufficiency on Organ Homeostasis, Behavior, Cancer and Chemotoxic Resistance in Aged Mice.**

Lee AS, [Brandhorst S](#), Rangel DF, Navarrete G, Cohen P, Longo VL, Chen J, Groshen S, Morgan TE, Dubeau L.

Scientific Reports. 2017 Feb 1;7:40919. PMID: 28145503

**Fasting Mimicking Diet Reduces HO-1 to Promote T cell-mediated Tumor Cytotoxicity.**

Di Biase S, Lee C, [Brandhorst S](#), Manes B, Buono R, Cheng CW, Cacciottolo M, Martin-Montalvo A, de Cabo R, Wei M, Morgan TE, Longo VD.

Cancer Cell. 2016 Jul 11;30(1):136-46. PMID: 27411588

**A Diet Mimicking Fasting Promotes Regeneration and Reduces Autoimmunity and Multiple Sclerosis Symptoms.**

Choi IY, Piccio L, Childress P, Bollman B, Ghosh A, [Brandhorst S](#), Suarez J, Michalsen A, Cross AH, Morgan TE, Wei M, Paul F, Bock M, Longo VD.

Cell Rep. 2016 Jun 7;15(10):2136-46. PMID: 27239035

**Safety and feasibility of fasting in combination with platinum-based chemotherapy.**

Dorff TB, Groshen S, Garcia A, Shah M, Tsao-Wei D, Pham H, Cheng CW, [Brandhorst S](#), Cohen P, Wei M, Longo V, Quinn DI.

BMC Cancer. 2016 Jun 10;16(1):360. PMID: 27282289

**A Periodic Diet that Mimics Fasting Promotes Multi-System Regeneration, Enhanced Cognitive Performance, and Healthspan.**

[Brandhorst S](#), Choi IY, Wei M, Cheng CW, Sedrakyan S, Navarrete G, Dubeau L, Yap LP, Park R, Vinciguerra M, Di Biase S, Mirzaei H, Mirisola MG, Childress P, Ji L, Groshen S, Penna F, Odetti P, Perin L, Conti PS, Ikeno Y, Kennedy BK, Cohen P, Morgan TE, Dorff TB, Longo VD.

Cell Metab. 2015 Jul 7;22(1):86-99. PMID: 26094889

**Starvation promotes REV1 SUMOylation and p53-dependent sensitization of melanoma and breast cancer cells.**

Shim HS, Wei M, [Brandhorst S](#), Longo VD.

Cancer Res. 2015 Mar 15;75(6):1056-67. PMID: 25614517

**Low protein intake is associated with a major reduction in IGF-1, cancer, and overall mortality in the 65 and younger but not older population.**

Levine ME, Suarez JA, [Brandhorst S](#), Balasubramanian P, Cheng CW, Madia F, Fontana L, Mirisola MG, Wan J, Passarino G, Kennedy BK, Cohen P, Crimmins EM, Longo VD.

Cell Metab. 2014 Mar 4;19(3):407-17. PMID: 24606898

**Short-term calorie and protein restriction provide partial protection from chemotoxicity but do not delay glioma progression.**

[Brandhorst S](#), Wei M, Hwang S, Morgan TE, Longo VD.

Exp Gerontol. 2013 Oct;48(10):1120-8. PMID: 23454633

**Spermidine promotes stress resistance in *Drosophila melanogaster* through autophagy-dependent and -independent pathways.**

Minois N, Carmona-Gutierrez D, Bauer MA, Rockenfeller P, Eisenberg T, Brandhorst S, Sigrist SJ, Kroemer G, Madeo F.

Cell Death Dis. 2012 Oct 11;3:e401. PMID: 23059820

**Fasting enhances the response of glioma to chemo- and radiotherapy. \***

Safdie F#, Brandhorst S#, Wei M, Wang W, Lee C, Hwang S, Conti PS, Chen TC, Longo VD.

PLoS One. 2012;7(9):e44603. PMID: 22984531

# Both authors contributed equally to this publication.

**Fasting cycles retard growth of tumors and sensitize a range of cancer cell types to chemotherapy.**

Lee C, Raffaghello L, Brandhorst S, Safdie FM, Bianchi G, Martin-Montalvo A, Pistoia V, Wei M, Hwang S, Merlino A, Emionite L, de Cabo R, Longo VD.

Science Translational Medicine. 2012 Mar 7;4(124):124ra27. PMID: 22323820

**Reviews and Proceedings:**

**Defining Prolonged and Intermittent Fasting: International Consensus on Fasting Terminology**

**The Effects of Dietary Interventions on Brain Aging and Neurological Diseases.**

Lobo F, Haase J, Brandhorst S.

Nutrients. 2022 Nov 30;14(23):5086. PMID: 36501116

**COMMENT: Breakfast keeps hunger in check.**

Brandhorst S, Longo VD.

Cell Metab. 2022 Oct 4;34(10):1420-1421. doi: 10.1016/j.cmet.2022.09.015. PMID: 36198286

**Time-Restricted Eating, Intermittent Fasting, and Fasting-Mimicking Diets in Weight Loss.**

Fanti M, Mishra A, Longo VD, Brandhorst S.

Current Obesity Reports. 2021 Jun;10(2):70-80. PMID: 33512641

**Fasting and fasting-mimicking diets for chemotherapy augmentation.**

Brandhorst S.

Geroscience. 2021 Jun;43(3):1201-1216. PMID: 33410090

**Periodic and Intermittent Fasting in Diabetes and Cardiovascular Disease.**

Crupi AN, Haase J, Brandhorst S, Longo VD.

Curr Diab Rep. 2020 Dec 10;20(12):83. PMID: 33301104

**Protein Quantity and Source, Fasting-Mimicking Diets and Longevity.**

Brandhorst S, Longo VD.

Advances in Nutrition. 2019 Nov 1;10. PMID: 31728501

**Personalized Nutrition: Translating the Science of NutriGenomics into Practice: Proceedings From the 2018 American College of Nutrition Meeting.**

Aruoma OI, Hausman-Cohen S, Pizano J, Schmidt MA, Minich DM, Joffe Y, Brandhorst S, Evans SJ, Brady DM.

J Am Coll Nutr. 2019 May-Jun;38(4):287-301. PMID: 31099726

**Dietary restrictions and nutrition in the prevention and treatment of cardiovascular disease.**

Brandhorst S, Longo VD.

Circulation Research. 2019 019 Mar 15;124(6):952-965. PMID: 30870119

**Protective effects of short-term dietary restriction in surgical stress and chemotherapy.**

Brandhorst S, Harputlugil E, Mitchell JR, Longo VD.

Ageing Res Rev. 2017 Feb 16. pii: S1568-1637(17)30033-8. PMID: 28216454

**Fasting and Caloric Restriction in Cancer Prevention and Treatment.**

Brandhorst S, Longo VD.

Recent Results Cancer Res. 2016;207:241-66. PMID: 27557543

**Book chapter:**

**Intermittent and Periodic Fasting, Aging and Disease**

**Chapter: Protein Restriction in Aging and Disease**

Springer, *proofs submitted*.

**Metabolism in Cancer**

**Chapter: Fasting and Caloric Restriction in Cancer Prevention and Treatment.**

Brandhorst S, Longo VD

ISBN 978-3-319-42116-2; Springer Publishing; 2016

**Judge for Peer Reviewed Articles:**

Including: Aging Cell, Cell Reports, Cell Metabolism, Nature Communications, JAMA Internal Medicine, PloS One, Journal of Nutrition, BMC Cancer,...

**Patents:**

**Methods and diets for lowering glucose and/or IGF-1 levels.**

Document Identifier US 20140227373A1

Publication Date 08.14.2014

[Also published as:](#) CA2900782A1, CN105008929A, EP2956776A2, US20140227373, WO2014127000A2

**Methods and Formulations Promoting Tissue/Organ Regeneration, Longevity and Healthspan.**

Document Identifier US 20140112909A1

Publication Date 04.24.2014

[Also published as:](#) CA2888811A1, EP2909802A1, WO2014066426A1

## **Media Reports:**

Please see <https://www.longolab.org/news-events> ; <http://l-nutra.com/news.aspx>

## **Scientific Presentations/Meetings:**

<b><u>Date</u></b>	<b><u>Conference Title</u></b>	<b><u>Presentation Title</u></b>	<b><u>Location</u></b>
April 2011	<b>American Association for Cancer Research (AACR)</b>	Fasting enhances the response of G126-glioma to radiation and multiple chemotherapies. ( <i>poster</i> )	Orlando, Florida
October 2011	<b>Moving Targets 2011: Aging and Oxidative Stress</b>		Los Angeles, California
August 2012	<b>Moving Targets 2012: Metabolic syndrome: Past, Present and Future</b>	Starvation sensitizes breast cancer by differential modulation of heme oxygenase-1. ( <i>poster</i> )	Los Angeles, California
February 2012	<b>Gordon Research Conference (GRC) on Aging, Biology</b>	Fasting cycles retard growth of tumors and sensitize cancer cells to chemotherapy. ( <i>poster</i> )	Ventura, California
10.06-10.07 2013	<b>Preclinical Imaging Workshop; Centers for Excellence in Research</b>	The application of small rodent imaging in fasting-related preclinical research.	Los Angeles, California
04.05-04.09 2014	<b>American Association for Cancer Research (AACR)</b>	Periodic fasting mimicking diet started late in life reduces and delays carcinogenesis. ( <i>poster</i> )	San Diego, California
02.17-02.18 2015	<b>USC Diabetes &amp; Obesity Research Institute; 2<sup>nd</sup> Annual Research Symposium</b>	The mitochondrial-derived peptide humanin enhances healthspan and improves metabolic markers in aged mice.	Los Angeles, California
10.06-10.09 2016	<b>The 8th International Congress of the GRS and IGF Society</b>	Fasting-mimicking diets lower IGF-1, promote regeneration, enhance cognitive performance and healthspan in mice, and reduce diabetes and cardiovascular disease risk factors in a randomized trial.	Tel Aviv, Israel
03.31-04.01 2017	<b>World Obesity Stock Conference 2017</b>	Periodic fasting mimicking diet - effects in humans.	Sydney, Australia
11.14-11.17 2017	<b>Biology of Ageing II "Impactful Interventions"</b>	Fasting-mimicking diet reduces risk factors for aging, diabetes, cancer and cardiovascular disease in preclinical and clinical studies. ( <i>oral presentation, poster</i> )	Singapore, Singapore
02.26-02.28 2018	<b>International Congress on Vegetarian Nutrition</b>	Protein quality and source, fasting mimicking diets and longevity.	Loma Linda, California
04.12-04.14 2018	<b>American Academy of Anti-Aging Medicine, A4M</b>	From Fasting to Fasting Mimicking Diets: Preclinical and Clinical Findings.	Hollywood, Florida
05.04-05.06 2018	<b>Australasian College of Nutritional and Environmental Medicine</b>	Fasting-mimicking diet reduces risk factors for ageing, diabetes, cancer and cardiovascular disease in preclinical and clinical studies.	Melbourne, Australia
05.31-06.02 2018	<b>The Institute for Functional Medicine: Annual International Conference</b>	Fasting and Autoimmune Disease	Hollywood, Florida

06.27-06.30 2018	<b>Nathan Shock Symposium at the AGE meeting</b>	Orentreich Symposium on Nutrition and Longevity: Fasting and Fasting-mimicking Diets in Health and Lifespan	Philadelphia, Pennsylvania
10.11-10.13 2018	<b>Personalized Lifestyle Medicine Institute: 2018 Thought Leaders Consortium</b>	The Science of the Fasting-mimicking Diet	Tucson, Arizona
11.07-11.09 2018	<b>American College of Nutrition: 2018 Personalized Nutrition</b>	Genes, Nutrition, Longevity and Chronic Disease.	Seattle, Washington
12.13-12.16.2018	<b>World Congress, American Academy of Anti-Aging Medicine, A4M</b>	Fasting, FMDs and the Inflammatory Response.	Las Vegas, Nevada
01.02-02.02.2019	<b>Can Chronic Disease Be Reversed?</b>	Fasting-mimicking diet reduces risk factors for ageing, diabetes, cancer and cardiovascular disease in preclinical and clinical studies	Orlando, Florida
02.15-02.16.2019	<b>8th Annual OncANP Conference</b>	Fasting and FMDs in Cancer Prevention and Treatment.	San Diego, California
06.18.2019	<b>Penn Center for Nutritional Science and Medicine</b>	The Fasting-Mimicking Diet and Inflammatory Bowel Disease: From Mice to Humans?	Philadelphia, Pennsylvania
07.10-07.11.2019	<b>The 20th Annual Harvard Nutrition and Obesity Symposium</b>	Ecuadorians with GH Receptor Deficiency: Lessons in Longevity	Boston, Massachusetts
09.28-09.29.2019	<b>8th Annual Integrative Medicine Conference, Osher Center for Integrative Medicine</b>	Inflammatory Bowel Disease: From Mice to Humans?	Fort Lauderdale, Florida
10.16-10.18.2019	<b>2019 Symposium on Healthy Aging, OFAS</b>	Fasting-mimicking diet reduces risk factors for ageing, diabetes, cancer and cardiovascular disease in preclinical and clinical studies.	New Paltz, New York
10.25.2019	<b>State of the Science, Uniformed Services University</b>	Low Calorie Diets for Chemotherapy Augmentation.	Bethesda, Maryland
10.26-10.28.2019	<b>Dietitians in Integrative and Functional Medicine</b>	Fasting and Fasting-Mimicking Diets in Health and Lifespan.	Philadelphia, Pennsylvania
11.12-11.13.2019	<b>RCCN Workshop Travel Awards for Early Career Investigators</b>	Resilience and Reserve in Aging	Austin, Texas
11.13-11.16.2019	<b>Gerontological Society of America</b>	Fasting-Mimicking Diet Reduces Risk Factors for Aging-Related Diseases in Preclinical and Clinical Studies	Austin, Texas
05.02.2020	<b>PLMI Spring Meeting</b>	Fasting-Mimicking Diets, Circadian Rhythms, and Metabolic Function	VIRTUAL
08.27.2020	<b>Nordic Laboratories</b>	The Fasting-Mimicking Diet: Recent Scientific Research and Updates	VIRTUAL
10.26.2020	<b>NCI Cancer and Aging Interest Group (CAIG)</b>	The Mechanisms of Fasting and Advanced Glycation End Products in Cancer Prevention in Elderly	VIRTUAL
12.18.2020	<b>NIH Lupus Workshop</b>	Fasting-Mimicking Diet and Autoimmune Diseases	VIRTUAL
04.13.2021	<b>NCI Cancer and Aging Interest Group (CAIG)</b>	Fasting and Fasting-Mimicking Diets in Cancer Prevention and Treatment	VIRTUAL
06.08.2021	<b>2021 ANCAM-AMESI</b>	Fasting-Mimicking Diets for the Treatment of Diabetes in Preclinical and Clinical Studies	VIRTUAL



03.11.2021	<b>Obesity Week</b>	Cyclical Dieting: Periodic Fasting as a Weight Loss Strategy	VIRTUAL
05.11.2021	<b>9<sup>th</sup> Annual Thought Leaders Consortium, PLMI</b>	Fasting-Mimicking Diet and Immune Rejuvenation	VIRTUAL
19.11.2021	<b>Inspire 2 Live, Lifestyle Congress</b>	Preclinical research and clinical trials done at USC and Italy regarding Fasting and Cancer	Amsterdam, The Netherlands
18.01.2022	<b>Trojan League</b>	Aging Research at USC	VIRTUAL
07.17.2023	<b>India at Home</b>	Fasting and Fasting-Mimicking Diets in Normal Aging and Disease	VIRTUAL
08.22.2023	<b>American Nutrition Association</b>	Fasting against Aging and Age-related Diseases	VIRTUAL