PURE Action, Inc. is a 501(c)3 nonprofit organization in the State of Texas. Our Mission is to bring the ancient benefits of yoga to modern medicine through scientific research, global education, and community yoga programs. Help us “Heal the World with Yoga!” Find out more at [www.pureaction.org](http://www.pureaction.org)
October 27, 2018

Welcome to the third annual Yoga Research Conference at the Thompson Conference Center at the University of Texas at Austin. We are excited to bring this unique gathering back to our home city of Austin, where we originally founded PURE Action, Inc. in 2011. Our mission is to “Heal the World with Yoga” by bringing the benefits of yoga to modern medicine through scientific research and global education while serving our local communities.

This year, Dr. Stacy Hunter stacy@pureaction.org has assembled a fantastic panel of scientists whose research will certainly inform and inspire you in your yoga practice and teaching. We hope that you enjoy the conference, make new friends, and share what you have learned back at your home yoga studio and home city. Furthermore, we are pleased that our conference is eligible for continuing education credits with both Yoga Alliance and the Original Hot Yoga Association.

We would like to give a special thank you to our Board Chairman, Chris Hager, who is sponsoring our Saturday evening Welcome Reception, and to all of our generous sponsors who have helped make this event possible.

Sincerely,

Jeff Chen
Executive Director
PURE Action, Inc.
pureaction.org
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Better ingredients: Using real ingredients like sea water and pink Himalayan salt for electrolytes and trace minerals can cost 100 times more than the common lab-made electrolyte alternatives. We are committed to using these better ingredients in Superieur Electrolytes for ourselves and our kids.

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Locally owned since 2003, we have served up hot yoga to over 50,000 students in four locations in the Greater Austin area. Owners Mardy Chen and Jeff Chen are founders of PURE Action, Inc., which has delivered over 5000 free yoga classes to underserved communities in Central Texas, including several addiction recovery centers. Also, find out more about our 9-week (May 28 to July 27, 2019) intensive hot yoga teacher training at the PURE Yoga Institute at pureyogainstitute.com. We believe that yoga can heal the world!

PureYogaTexas.com

Shudh Natural Internal Cleanse: Dr. Vijaypal Arya, MD

Shudh is a modern version of Shankh Prakshalana, an Indian purification technique that has been used for over 2500 years. This technique cleanses the bowel naturally, using only salted water and a series of five yoga exercises. Instead of chemical action, the body’s own reflexes do the work. The Shudh process is ideal for healthy men and women who are fit enough to do a little exercise. Dr. Vijaypal Arya, MD, is a gastroenterologist in New York who developed the Shudh product and uses this method for colonoscopy preparation with great results versus traditional modern methods.

shudhinc.com
Saturday, October 27, 2018

9:30 am to 10:30 am  Registration and Continental Breakfast

10:30 am to 10:45 am  Guided Meditation with The Art of Living Foundation

10:45 am to 11:00 am  Welcome Address:
- Jeff Chen, Executive Director, PURE Action, Inc.
- Dr. Stacy Hunter, PhD, Research Director, PURE Action, Inc.

Presentations and Panel Discussion:

11:00 am to 11:25 am  “Hot Yoga and the Aging Arteries”
- Dr. Stacy Hunter, PhD - Pure Action, Inc. & Texas State University

11:25 am to 12:00 pm  “Thermoregulation in Health and Disease”
- Dr. Craig Crandall, PhD - University of Texas Southwestern Medical Center

12:00 pm to 12:25 pm  “Cardiovascular and Neural Adaptations to Hot Yoga versus Normal Temperature Yoga”
- Dr. Micah Zuhl, PhD - University of New Mexico

12:25 pm to 12:50 pm  “Efficacy of Hot Yoga as a Heat Stress Technique for Enhancing Plasma Volume and Cardiovascular Performance in Elite Female Field Hockey Players”
- Dr. Andrew Perrotta, PhD, CEP, CSCS – Langara College

12:50 pm to 1:15 pm  “The Effect of Bikram Yoga on Heart Rate Variability and Associated Outcomes in Stressed and Sedentary Adults”
- Dr. Zoe Hewett, PhD – Western Sydney University (alumni)

1:15 pm to 1:30 pm  Panel Discussion

1:30 pm to 2:30 pm  Networking Lunch Sponsored by Superieur Electrolytes

2:30 pm to 3:30 pm  Poster Presentations Sponsored by PURE Yoga Texas and PURE Yoga Institute
“A Comparison of Blood Viscosity and Hematocrit Levels between Yoga Practitioners and Sedentary Adults”
- James Shadiow, CSCS – Texas State University

“Modifications Taken in a Yoga Practice in Overweight versus Normal Weight Individuals”
- Sally Sherman, PhD – University of Pittsburgh

“Physiological and Behavioral Effects of TIYT-OAnx Protocol on Adults with Trauma History”
- Keri Heilman, PhD - University of North Carolina, Chapel Hill

“Brief Yoga Compared to Psychoeducation for Test Anxiety: A Randomized, Controlled Experiment”
- Sasha Flowers – University of Texas at Austin

“Objective and Subjective Measures of Exercise Intensity During Thermo-neutral and Hot Yoga”
- Micah Zuhl, PhD – University of New Mexico

Presentations and Panel Discussion:

3:30 pm to 4:05 pm  “Slow breathing - Physiology and Clinical Applications”
- Dr. Luciano Bernardi, MD - University of Pavia, Italy

4:05 pm to 4:30 pm  “Ancient Mantras to Molecular Mechanisms”
- Dr. Sundar Balasubramanian, PhD - Medical University of South Carolina
**Continental Breakfast**

**9:30 am to 10:30 am**

**Special Presentation by Dr. Vijaypal Arya, MD**

“Shudh, a Modern Version of Shankha Prakshalana”

**Presentations and Panel Discussion:**

- **11:00 am to 11:25 am**
  “Energy Expenditure in Vinyasa Yoga Versus Walking”
  - Dr. Sally Sherman, PhD - University of Pittsburgh

- **11:25 am to 11:50 am**
  “Comparison of Trunk and Hip Activation during Yoga Postures between Males and Females.”
  - Dr. Lori A. Bolgla, PT, PhD, MAcc, ATC – Augusta University

- **11:50 am to 12:15 pm**
  “Yoga Posture Analysis Using a 3D Room Sensor for Cardiac and Other Special Patients”
  - Dr. Paula R. Seffens, PhD – University of North Georgia

- **12:15 pm to 12:40 pm**
  “Resident Wellness Program Initiative: Yoga Classes During Didactics”
  - Dr. Shilpa Babbar, MD

**Panel Discussion**

**1:00 pm to 2:00 pm**

**Lunch Sponsored by Raja Yoga Academy and Modern Holistic Health**

**Presentations and Panel Discussion:**

- **2:00 pm to 2:25 pm**
  “The Meaning of ‘Now’ Moments of Engagement in Yoga for Persons with Alzheimer’s Disease”
  - Dr. Lyn Litchke, PhD - Texas State University

- **2:25 pm to 2:50 pm**
  “Mandala Yoga for Youth with Autism Spectrum Disorder”
  - Dr. Lyn Litchke, PhD - Texas State University

- **2:50 pm to 3:15 pm**
  “Yoga Meditation (YoMed) and its Effect on Proprioception and Balance Function in Elders who have Fallen: A Randomized Control Study”
  - Savannah Wooten, M.S. – University of Texas at Austin

**Panel Discussion**

**3:15 pm to 3:30 pm**

**Closing Remarks:**

- Dr. Stacy Hunter, PhD, Research Director, PURE Action, Inc.
- Mardy Chen, Founder, PURE Action, Inc.
Luciano Bernardi, MD - University of Pavia, Italy

“Slow breathing - Physiology and Clinical Applications”

Luciano Bernardi, MD (Verona, Italy, in 1950), is full professor of Internal Medicine at the University of Pavia, Italy, and after his retirement is presently affiliated at the University of Helsinki, Finland. His main research interests focus on the integrated control mechanisms of the cardiovascular and respiratory systems. In this context he has done extensive research work on the physiological effects and clinical applications of yoga in relevant diseases like heart failure, hypertension, chronic obstructive pulmonary diseases and more recently on diabetes. In addition, he studied the effects of special respiratory adaptations during exposure to high altitude hypoxia, taking part or leading seven high altitude stages, in the Himalayas and in the Andes, and during simulated experiments in hypobaric chambers. He also studied the cardio-respiratory effects of listening to music, praying and chanting. His current research focuses on the relationship between hypoxia and diabetes, and the effects of pranayama on diabetes.

His research work results from collaboration with numerous research Institutions in Europe India, United States and South America. His work is published in more than 200 peer-review journals.

Craig Crandall, PhD - University of Texas Southwestern Medical Center

“Thermoregulation in Health and Disease”

Dr. Crandall completed a Ph.D. in Biological Sciences with emphasis on Physiology from the University of North Texas Health Science Center in Fort Worth. He then completed a 3-year post-doctoral fellowship in the Department of Physiology at the University of Texas Health Science Center San Antonio. He is currently a Professor of Internal Medicine at the University of Texas Southwestern Medical Center and the Director of the Thermal and Vascular Physiology Laboratory at the Institute for Exercise and Environmental Medicine.

Stacy Hunter, PhD - Pure Action, Inc. & Texas State University

“Hot Yoga and the Aging Arteries”

Dr. Stacy D. Hunter received her Ph.D. in Clinical Exercise Physiology from the University of Texas at Austin where she studied the effects of yoga on vascular function in the Cardiovascular Aging Research Laboratory. A yoga practitioner since 2008, she has now published several pioneering studies on the impact of yoga on vascular endothelial function, arterial stiffness, and glucose tolerance and presented her findings at teacher trainings, yoga studios and symposia in the U.S. and abroad. In addition to being Pure Action’s Research Director, she is also currently an Assistant Professor in the Department of Health and Human Performance at Texas State University where she continues her investigation into the acute and chronic effects of yoga on vascular health and other coronary heart disease risk factors in healthy and clinical subpopulations.
Sundar Balasubramanian, PhD - Medical University of South Carolina

“Ancient Mantras to Molecular Mechanisms”

Dr. Sundar Balasubramanian is a Cell Biology researcher. He is currently studying mechanisms involved in resistance to cancer therapy at the Medical University of South Carolina. He is also a Yoga Biology researcher. Two of his seminal research papers have provided clinical evidence on how Yogic breathing practices could promote well being by changing the expression of key salivary proteins. Sundar grew up in Tamilnadu, India in a traditional Yoga and Siddha medicine practicing family background; and went to Swami Chithbhavananda’s Vivekananda College in India where he further learned Yoga, Meditation, and Kirtan practices. He is an internationally certified and registered Yoga teacher and a Certified-International Association of Yoga Therapist, and a member of the Integral Yoga Teachers Association. He was a speaker of TEDx Charleston in 2015, and the author of a recent book “PranaScience - Decoding Yoga Breathing”

Kasey Claborn, PhD - The University of Texas at Austin Dell Medical School

“The Utility of Yoga in the Treatment of Opioid Use Disorders: A Qualitative Investigation”

Dr. Claborn is a clinical psychologist and Assistant Professor in the Department of Psychiatry at The University of Texas Dell Medical School. She received her Ph.D. from Oklahoma State University and completed a residency at the University of Florida Health Sciences Center. She completed her postdoctoral fellowship at Brown University’s Center for Alcohol and Addiction Studies where she gained expertise on the prevention and treatment of addictions. Dr. Claborn is the Principal Investigator of two NIDA-funded studies including a Career Development Award. Her research focuses on treatment development for people who use drugs and improving the system of care delivery.

Lyn Litchke, PhD - Texas State University

“The Meaning of ‘Now’ Moments of Engagement in Yoga for Persons with Alzheimer’s Disease”

AND “Mandala Yoga for Youth with Autism Spectrum Disorder”

Dr. Lyn Litchke is an Associate Professor of Therapeutic Recreation in the Department of Health and Human Performance at Texas State University where she has taught for 16 years. She is the 2016 recipient of the Presidential Award for Excellence in Service. Lyn has been a Certified Recreation Therapy Specialist for over 30 years, and is currently certified as a master trainer in Drums Alive Drumtastic®, 200 hr. Integrative Yoga Therapy, Lakshmi Voelker Chair Yoga, and Kid Yoga Fit. Her research focuses improving quality of life for persons with disabilities through various therapeutic recreation interventions, in particular yoga as an intervention for persons with Alzheimer’s disease and youth with Autism Spectrum Disorder.

Dr. Micah Zuhl, PhD - University of New Mexico

“Cardiovascular and Neural Adaptations to Hot Yoga versus Normal Temperature Yoga”

Dr. Zuhl’s previous research work has focused on examining the effect of exercise in various environmental conditions (i.e. heat). More recently, he gained interest in exploring mechanisms of how alternative exercise therapies (e.g. yoga, HIIT, dance) affect the brain and cardiovascular system. The aim is to identify appropriate exercise therapies for psychological, behavioral, and heart disease conditions.
Sally Sherman, PhD - University of Pittsburgh

“Energy Expenditure in Vinyasa Yoga Versus Walking”

Sally Sherman, Ph.D. is a triathlete, yogi and educator in Pittsburgh, PA. Sally holds a B.A. in Dance, an M.Ed. in Teaching, an M.S. in Exercise Science and a Ph.D. in Exercise Physiology. She serves as a faculty member at the University of Pittsburgh in the Department of Health and Physical Activity. In addition, she is a researcher at the Physical Activity and Weight Management Research Center within the Healthy Lifestyle Institute. Dr. Sherman's dissertation work studied "Energy Expenditure in Yoga Versus Other Forms of Physical Activity" and revealed that Vinyasa Yoga meets exercise requirements, despite not meeting recommendations set by the American College of Sports Medicine. This study has been published in the Journal of Physical Activity and Health.

Dr. Sherman is a lululemon ambassador and is certified in Indoor Cycling, Pilates and Yoga. She has led and assisted teacher trainings all over the world. As a triathlete, Dr. Sherman is a sponsored athlete competing in long-distance cycling events, marathons and IRONMAN triathlons. She uses these events to raise money for local charities including food banks, the Salvation Army and Toys for Tots. As a melanoma survivor, she aims to bring awareness to skin cancer prevention, especially among the athletes who spend so much time in the sunshine.

Lori A. Bolgla, PT, PhD, MAcc, ATC - Augusta University

"Comparison of Trunk and Hip Activation during Yoga Postures between Males and Females."

Lori A. Bolgla, PT, PhD, MAcc, ATC is a Professor in the Department of Physical Therapy and Kellett Chair in Allied Health Sciences at Augusta University (formerly the Medical College of Georgia). She received her B.S. and Advanced Master's degrees in Physical Therapy from the Medical College of Georgia and her Ph.D. in Rehabilitation Sciences from the University of Kentucky. She has advanced knowledge of kinesiological EMG and its applications to exercise prescription. Dr. Bolgla has devoted a substantial amount of time over the past 15 years reviewing evidence-based literature and conducting research pertinent to sports medicine and orthopedic-based problems.

Paula R. Seffens, PhD - University of North Georgia

“Yoga Posture Analysis using a 3D Room Sensor for Cardiac and other Special Populations”

Yoga has been a part of Paula Seffens’ life since her early teens. For the past 25 years, she taught regularly, studied iyengar and Ashtanga styles and developed an eclectic style of yoga. In 2013, she earned the Yoga Alliance 500-hour Registered Yoga Teacher (RYT) certification. As a Clinical Exercise Physiologist, with a Ph.D. in Kinesiology and an undergraduate degree in Psychology, Paula has a deep commitment to scientifically studying ways to deliver yoga to medically and socio-economically disadvantaged people. Currently, her research involves the development of yoga instruction and feedback using 3D room sensors.

Savannah Wooten, M.S. - University of Texas at Austin

“Yoga Meditation (YoMed) and its effect on proprioception and balance function in elders who have fallen: A randomized control study”

Ms. Wooten is a current PhD Student at the University of Texas at Austin in the Kinesiology & Health Education Department. She holds a B.S. from Indiana University in Biology and a M.S. from the University of Miami in Clinical Exercise Physiology. Wooten is a 200hr RYT and has focused her academic career on studying the clinical and physical benefits of yoga.
Dr. Andrew S. Perrotta, PhD, CEP, CSCS – Langara College
“Efficacy of Hot Yoga as a Heat Stress Technique for Enhancing Plasma Volume and Cardiovascular Performance in Elite Female Field Hockey Players”
Dr. Perrotta completed his Ph.D. in Experimental Medicine at the University of British Columbia, with a research focus on cardiovascular function in elite athletes. His research pertains to examining heart rate dynamics during exercise, the response of the autonomic nervous system to exercise using heart rate variability and utilizing heat stress techniques for augmenting blood volume and cardiovascular performance. As a sport physiologist, he has published studies examining the validity of a HRV smartphone application, the efficacy of hot yoga to improve cardiovascular performance and novel techniques to prospectively design and deliver exercise-training programs that achieve the desired training intensity.

Zoe Hewett, PhD, Western Sydney University (alumni)
"The Effect of Bikram Yoga on Heart Rate Variability and Associated Outcomes in Stressed and Sedentary Adults"
Dr Hewett completed a PhD in Exercise Physiology at Western Sydney University during which she used a randomised controlled trial to examine the effects of Bikram yoga on sedentary and stressed adults. Dr Hewett's graduate work (M.S. in Exercise Science) examined the effect of Bikram yoga on mindfulness and physical fitness. Dr Hewett holds several yoga certifications (Bikram yoga, 200hr Level 1 Purna yoga, Rainbow Kids yoga, Bliss Baby Pre/post natal yoga), is an accredited (Australia) Exercise Physiologist, and co-owns a Bikram yoga studio in Canberra, Australia. Dr Hewett aims to empower people to engage in self-care through the integration of yoga practices into modern life.

Dr. Shilpa Babbar, MD – Saint Louis, MO
"Resident Wellness Program Initiative: Yoga Classes During Didactics"
Shilpa Babbar, MD, MS is a Maternal-Fetal Medicine specialist in St. Louis, Missouri. She earned her medical degree from Kasturba Medical College, India. She completed her Obstetrics and Gynecology residency at Eastern Virginia Medical School, Virginia and Maternal-Fetal Medicine fellowship at the University of Missouri Kansas City. Her clinical research interests include evaluating the effects and benefits of exercise and yoga during pregnancy. She has recently been involved in creating wellness initiatives to address physician burnout specifically during residency training. She has authored several peer-reviewed publications on prenatal yoga. Dr. Babbar is also a 200-hour and prenatal certified yoga instructor who teaches yoga regularly.
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“The Art of Living is more of a principle, a philosophy of living life to its fullest. It is more a movement than an organization. Its core value is to find peace within oneself and to unite people in our society – of different cultures, traditions, religions, nationalities; and thus reminding us all that we have one goal to uplift human life everywhere.” – Sri Sri Ravi Shankar

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Raja Yoga Academy

Through honest and respectful communication, we at Raja Yoga Academy hope to inspire ethical, compassionate, and confident leaders. Much more than just a hot yoga teacher training, RYA offers an unparalleled experience in personal and professional development. Whether you aspire to teach, teach more effectively, or simply desire to advance your practice, we are confident that you will experience profound growth, both on and off the mat.

RYA training programs focus our intensive curriculum through a therapeutic lens and advocate perpetual refinement through further education and experience in the field. We encourage respectful collaboration and communication between all styles and methods of yoga. Our faculty and graduates form a global community of passionate educators dedicated to transforming themselves and others, that we may together transform our world. Simply put, we teach to heal.

www.rajayogaacademy.com

Yogangster

Yoganger is the creation of Goldie – internationally renowned DJ, artist and yoga enthusiast - who has been sharing his love of yoga around the world since beginning his practice in 2010. Meeting Yogangster business partner and Hot Yoga instructor Kelly Isaac in the sweaty environment of a Bikram studio in London led to the launch of the first Yogangster active wear & accessories collection in Spring 2015. Yogangster active wear is made using the latest technology fabrics and designed with Goldie’s keen eye for fashion. Never one to skimp on detail it fuses strong bold colours and prints in shapes that deliver the ultimate in quality products that help you look, feel and perform at your best. We believe that looking good in the studio is as important as looking good outside. Encompassing a collection of loungewear & accessories Yogangster is the brand to take you from the street to the studio to a better version of yourself. Yogangsters approach their practice with the same fierce determination they do every other part of lives, openly, determined to succeed, rarely playing by the rules, always willing to try, never willing to give up. What we do today, creates tomorrow. We invite you to join us on the journey...

www.yogangster.co.uk

Modern Holistic Health

Modern Holistic Health offers a natural health solution that helps put the body back in order so you can begin the healing process. We practice holistic medicine to develop personalized plans for our patients under the direction of holistic doctor, Elena Villanueva DC in Austin, TX. We work to identify the root cause of problems with precision. We analyze symptoms and then design a custom health and recovery program based on each patient’s individual genetic makeup, chemistry, and lifestyle.

Dr. Elena Villanueva DC, or Dr. V, is a holistic doctor who practices holistic care in Austin, Texas. Dr. V’s passion is supporting people in their search for healthier alternatives in healing their chronic conditions and working with individuals looking to establish a healthier lifestyle. Dr. V’s specializations include: balancing female hormones, supporting auto immune disorders, type II diabetes, neuro chemical imbalances, genetic defects including MTHFR, insomnia, metabolic syndrome, and others.
SPEAKER ABSTRACTS

**Effects of Yoga Interventions Practiced in Heated and Thermoneutral Conditions on Endothelium-Dependent Vasodilation: The Bikram Yoga Heart Study**

**Stacy D. Hunter, PhD, Jitanan Laosiripisan, PhD, Ahmed Elmenshawy, PhD and Hirofumi Tanaka, PhD, Texas State University, San Marcos, Texas, 78666 The University of Texas at Austin, Texas, 78712**

We have previously documented improvements in endothelium-dependent vasodilation with a Bikram (hot) yoga intervention in middle-aged adults. Presently, the effect of environmental temperature in hot yoga on endothelial function is unknown. **PURPOSE:** The purpose of this investigation was to determine the effects of Bikram yoga interventions performed in the heated and thermoneutral conditions on endothelium-dependent vasodilation. **METHODS:** Fifty-two sedentary but apparently healthy adults aged 40-60 years were randomly assigned to one of three groups: Bikram yoga practiced at 40.5°C (n=19), Bikram yoga practiced at 23°C (n=14), or sedentary time-control (n=19). The yoga interventions consisted of 90-minute Bikram yoga classes 3 times a week for 12 weeks. Endothelium-dependent vasodilation was measured noninvasively using brachial artery flow-mediated dilation (FMD). **RESULTS:** Age, anthropometric variables, plasma lipid and glucose concentrations and brachial artery FMD at baseline were not different among the three groups. Body fat percentage determined via dual energy x-ray absorptiometry declined (p<0.01), and total (p=0.051) and LDL-cholesterol concentrations (p=0.09) tended to be reduced only in the hot yoga group after the intervention. Brachial artery FMD increased (P<0.05) in both yoga groups. There were no significant changes in any outcome variables in the time control group. **CONCLUSIONS:** Bikram yoga practiced in heated and thermoneutral conditions produced similar improvements in endothelium-dependent vasodilation in healthy, middle-aged adults. These novel findings highlight the effectiveness of hatha yoga postures alone, in the absence of a heated practice environment, in improving vascular health and are of clinical significance given the increased propensity toward heat intolerance in aging adults.

This study was funded by Pure Action, Inc. Austin, Texas, USA

**Cardiovascular and neural adaptations to 4-weeks of hot yoga compared to normal temperature yoga.**

**Kelsey Bourbeau, M.S., Terence Moriarty, M.S., Bryanne Bellovary, M.S., Truman Haeny, B.S., Gabrielle Bellissimo, M.S., Valarie Maestas, B.S., and Micah Zuhl, Ph.D. University of New Mexico, Albuquerque, NM, USA.**

Heat stress requires an integrative cardiovascular response that drives hemodynamics in an effort to regulate core temperature. Chronic heat exposure improves the ability of an organism to cope with hot environments through both cardiovascular and cellular adaptations. Hot temperature yoga has grown in popularity, and combines mind-body exercises with heat exposure. Heightened hemodynamic responses that occur during hot yoga may have added cardiovascular and cellular benefits beyond normal temperature yoga. The heat component may also enhance neural changes that have been previously demonstrated in response to normal temperature yoga, including neurogenesis and modulation of the autonomic nervous system (ANS). Little is known about the cardiovascular, cellular, and neural adaptations to chronic hot yoga exposure. **PURPOSE.** Therefore, the purpose of this study is to compare cardiovascular and neural adaptations of hot yoga versus normal temperature yoga; and to examine the activation of key cellular stress proteins (e.g., HSP70). **METHODS.** Twelve subjects (males = 7, females = 5, 29 ± 5.9 years) completed 4-weeks of normal (n=4) or hot (n=7, 41°C, 40% humidity) temperature yoga. The yoga was performed 3 times/wk following a modified Bikram protocol. Pre- and post-testing included: 1. Hemodynamic analysis from heat tolerance testing and maximal aerobic fitness; 2. Neural response using ANS marker (heart rate variability), plasma BDNF, and adrenocorticotropic hormone. **PRELIMINARY RESULTS.** Maximal aerobic fitness increased in the hot yoga group only
(43.29 ± 10.36 vs. 46.58 ± 9.85 ml.kg.min⁻¹). Peak heart rate was lower during the HTT after 4 weeks of hot yoga only (170 ± 21 vs. 165 ± 21 bpm). Preliminary serum BDNF results show a 6-fold increase in the hot yoga group. **CONCLUSIONS.** Twelve sessions of hot yoga improved both cardiovascular fitness and hemodynamics in comparison to normal temperature yoga. In addition, serum BDNF increased after hot yoga indicating evidence of neural plasticity.

**Efficacy of Hot Yoga as a Heat Stress Technique for Enhancing Plasma Volume and Cardiovascular Performance in Elite Female Field Hockey Players**

Andrew S. Perrotta, PhD, Matthew D. White, PhD, Michael S. Koehle, MD, PhD, Jack E. Taunton, MD, and Darren E.R. Warburton, PhD. The University of British Columbia, Vancouver, BC, Canada

The rapid development of hypervolemia from experiencing repeated heat stress has shown to augment maximal cardiac output, stroke volume, and aerobic power (VO2max) in both hot and cool environments. Such physiological and performance adaptations may be beneficial for elite female field hockey players where elevated and sustained cardiovascular performance is critical for achieving on-field success. **PURPOSE:** This investigation examined the efficacy of hot yoga as an alternative heat stress technique for enhancing plasma volume percentage (PV%) and cardiovascular performance.

**METHODS:** Ten international calibre female field hockey players completed six, 60-min hot yoga sessions (30.0 ± 1.8°C, RH% = 47.6 ± 8.8) utilizing permissive dehydration over six days, followed by a six day national team camp. Changes in PV% were examined throughout the intervention and post-intervention period. A graded maximal exercise test was performed in a thermoneutral environment (23.2 ± 1.0 °C) 24 hr prior to and 24 hr post-intervention. **RESULTS:** The development of hypervolemia coupled with trivial improvements in VO2max was observed after six days of hot yoga. Improvements (ES > 0.20) in running speed at each ventilatory threshold (VT1 & VT2) along with positive adaptations in the respiratory exchange ratio during high intensity exercise were identified. A large plasma volume expansion transpired 72 hr post-intervention [PV% = 5.0%] that contracted to a small expansion after six days removed from hot yoga [PV% = 1.6%]. **CONCLUSION:** This investigation provides practitioners an alternative heat stress technique conducive for team sport, involving minimal exercise stress that can preserve maximal cardiovascular performance over periodized rest weeks within the yearly training plan. Furthermore, improvements in submaximal exercise and a delayed hypervolemic response may provide a performance enhancing effect when entering a six day competition period.

This study was funded in part by the Natural Sciences and Engineering Research Council of Canada, BC, Canada,

**Effect of Bikram Yoga on Heart Rate Variability and Associated Outcomes in Stressed and Sedentary Adults**

1Zoe L. Hewett, PhD, 2Kate L. Pumpa, PhD, 3Caroline A. Smith, PhD, 1Paul P. Fahey, MMedStat, 1,2Birinder S. Cheema, PhD Affiliations: 1School of Science and Health, Western Sydney University, Penrith, NSW 2751, Australia 2National Institute of Complementary Medicine, Western Sydney University, Penrith, NSW 2751, Australia. 3Research Institute for Sport and Exercise, University of Canberra, Canberra, ACT 2617, Australia

**PURPOSE:** This study investigated the effect of a 16-week Bikram yoga intervention on the high frequency (HF) power component of heart rate variability (HRV) and associated physiological and psychological outcomes in stressed and sedentary adults. **METHODS:** Eligible adults were randomized to an experimental group (n=29) or a no-treatment control group (n=34) after baseline testing. Experimental group participants were instructed to attend three to five Bikram yoga classes per week at local studios. All outcomes were collected at baseline (week 0) and completion (week 17), with psychological outcomes also collected at midpoint (week 8). Secondary physiological outcomes included additional HRV measures, blood pressure, augmentation index, body composition (via DEXA), waist circumference, fasting blood glucose, cholesterol, and C-reactive protein. Secondary psychological outcomes included the Perceived Stress Scale, the General- and Exercise Self-Efficacy Scales and
health-related quality of life (HRQoL) measures (via Short-Form-36). RESULTS: Sixty-three adults (37.2±10.8 years, 79% women) were enrolled in the study and included in the intention-to-treat analysis. The experimental group attended 27±18 classes. The HF component of HRV did not significantly change between groups over time, nor did any secondary physiological endpoints. However, higher attendance to the intervention was associated with significant reductions in diastolic blood pressure (p=0.039), body fat percentage (p=0.001), fat mass (p=0.003) and body mass index (p=0.05). The experimental group significantly improved several psychological endpoints versus the control group including perceived stress (p = 0.003), general self-efficacy (p=0.034), exercise self-efficacy (p=0.003), and HRQoL ‘Vitality’ (p=0.019) and ‘General Health’ (p=0.034). Difficulty committing to the trial, lack of enjoyment and adverse events were barriers to adherence. CONCLUSION: A 16-week Bikram yoga program did not increase the HF power component of HRV or any physiological outcomes evaluated. Low adherence possibly contributed to these null effects. However, participants in the experimental group significantly improved perceived stress, and measures of self-efficacy and HRQoL. Future studies are required to address barriers to adherence and elucidate the dose-response effects of Bikram yoga practice.

Slow breathing - Physiology and clinical applications

Luciano Bernardi, MD, Folkhälso Institute of Genetics, Folkhälso Research Center, University of Helsinki, Finland

In recent years, accumulating evidence suggests that yoga (and particularly the slowing of breathing rate) can have a specific beneficial effect in cardiovascular and respiratory diseases, by improving the autonomic function, the pulmonary gas exchange, and possibly also the endothelial function and oxidative stress.

Conditions like exposure to lack of oxygen (high altitude) induce short- and long-term modifications the cardio-respiratory control, characterised by a decrease in the baroreflex sensitivity and by an increase in chemoreflex sensitivity, as part of the normal acclimatisation process. However, similar modifications are also an early sign of dysfunction in several important cardiovascular (particularly heart failure) and also respiratory diseases (COPD and asthma). The practice of slow and deep breathing, as can be obtained by pranayama techniques, increases resting oxygen saturation at high altitude despite a reduced ventilation, and maintains higher baroreflex sensitivity and parasympathetic activity. Application of this technique to patients with heart failure resulted in improved blood oxygenation, autonomic balance and exercise tolerance.

Recent studies from our group indicate that similar alterations in cardio-respiratory control are typically observed also in diabetes. We have shown that diabetic patients tend to have a reduced resting oxygen saturation, a finding implicating a resetting of cardiorespiratory reflexes. These abnormalities could be acutely relieved by slow breathing, which showed an immediate improvement not only in oxygen saturation but also in autonomic function (baroreflex sensitivity). These findings challenge the long-established concept that autonomic abnormalities were the result of a neural loss, suggesting now a functional imbalance, and thus the possibility of correction by functional interventions, like physical activity and perhaps yoga. In addition, we have found that respiration interact with both at the autonomic and the vascular function in diabetes. Thus, slowing the breathing rate was associated with an acute improvement in arterial function (pulse wave velocity and augmentation index) in both type 1 and type 2 diabetes. Furthermore, while the improvement in baroreflex sensitivity was also seen with oxygen administration (confirming the presence of underlying hypoxic condition in diabetes), the effects of oxygen were opposite on the arterial function, suggesting a possible effect of oxygen as a free radical donor. However, when slow breathing was associated with oxygen administration the arterial function was restored, hence suggesting that slow breathing could have some direct antioxidant effect.

These findings confirm that appropriate manipulations of ventilatory pattern, as could be obtained by simple pranayama techniques may favourably modify the cardio-respiratory control and other relevant physiological functions, with potential important benefits in critical -environmental or pathologic- conditions.
Regulated breathing from the Yoga tradition (Pranayama) has several health benefits. There are numerous exercises available in ancient Yoga literature for regulated breathing. Our research involves the mechanisms and applications of Pranayama in health and in chronic illnesses. Based on an ancient poem from a Tamil Yoga literature, called Thirumanthiram, I devised and tested a Yogic breathing exercise involving inhalation, breath holding, and exhalation. Our studies indicate that this exercise 1) stimulated salivary secretion, 2) saliva contained increased amounts of nerve growth factor, 3) several biomarkers are differentially expressed in saliva after Yogic breathing, suggesting a beneficial physiological status. These proteins include immunoglobulins, and tumor suppressors, and 4) reduces salivary pro-inflammatory cytokines (IL-1beta, IL-8, and MCP-1). A weekly Yogic breathing program provided to cancer patients and caregivers in the past 2 years have produced improvement in the psychological stress, mood, relaxation, appetite and pain. Other clinical applications of Yogic breathing are discussed. Our studies are first of its kind combining biomarkers and Yogic breathing, and point to a potential clinical application in the future for a wide range of chronic conditions and well being.

The United States is experiencing a worsening opioid epidemic with over 2.6 million people living with an opioid use disorder. Current evidence-based treatment includes medication assisted therapy (MAT) combined with psychotherapy; however, many of these individuals experience comorbidities which may benefit from alternative therapies. PURPOSE: The purpose of this study was to inform development of an intervention to improve treatment adherence and retention for people with opioid use disorders and comorbid medical conditions. METHODS: Individual interviews (IDIs) were conducted with 29 community-based clinicians. Clinician participants were employed within local treatment facilities, were specialized in either addiction medicine or infectious disease, and had a minimum of one year work experience with people who use drugs. IDIs were 45-90 minutes and followed a semi-structured guide. Topics included: (1) experiences working with the target population; (2) brainstorming intervention content; and (3) perceived system-level gaps. Participants received $40 for participating. Data was analyzed using applied thematic analysis. RESULTS: Analyses highlighted current gaps in treatment including a need to provide distress tolerance skills, increase social support and community, stress management, and finding a purpose. A few participants noted that the clinic previously offered yoga classes; however, they were poorly attended and discontinued likely as a result of a less experienced yoga teacher who was unable to connect with a mostly disenfranchised population. CONCLUSION: The highlighted treatment gaps can be addressed through yoga as an adjunctive intervention to MAT; however, it may be necessary to develop a culturally tailored intervention to increase acceptability and attendance among vulnerable populations who traditionally have limited access and experience with yoga. Development of a culturally tailored yoga-based opioid treatment intervention may provide patients with necessary skills to titrate off MAT instead of taking MAT throughout the life course.

This research was supported by grant number K23 DA039037 from the National Institutes of Drug Abuse, USA.

Energy Expenditure in Vinyasa Yoga Versus Walking

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Whether the energy cost of vinyasa yoga meets the criteria for moderate-to-vigorous physical activity has not been established. **PURPOSE:** To compare energy expenditure during acute bouts of vinyasa yoga and 2 walking protocols. **METHODS:** Participants (20 males, 18 females) performed 60-minute sessions of vinyasa yoga (YOGA), treadmill walking at a self-selected brisk pace (SELF), and treadmill walking at a pace that matched the heart rate of the YOGA session (HR-Match). Energy expenditure was assessed via indirect calorimetry. **RESULTS:** Energy expenditure was significantly lower in YOGA compared with HR-Match (difference = 79.5 ± 44.3 kcal; \( P < .001 \)) and SELF (difference = 51.7 ± 62.6 kcal; \( P < .001 \)), but not in SELF compared with HR-Match (difference = 27.8 ± 72.6 kcal; \( P = .054 \)). A similar pattern was observed for metabolic equivalents (HR-Match = 4.7 ± 0.8, SELF = 4.4 ± 0.7, YOGA = 3.6 ± 0.6; \( P < .001 \)). Analyses using only the initial 45 minutes from each of the sessions, which excluded the restorative component of YOGA, showed energy expenditure was significantly lower in YOGA compared with HR-Match (difference = 68.0 ± 40.1 kcal; \( P < .001 \)) but no compared with SELF (difference = 15.1 ± 48.7 kcal; \( P = .189 \)). Conclusions: YOGA meets the criteria for moderate-intensity physical activity. Thus, YOGA may be a viable form of physical activity to achieve public health guidelines and to elicit health benefits.

**Comparison of Trunk and Hip Activation during Yoga Postures between Males and Females**

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Yoga has become a popular form of exercise for individuals with low back pain since many postures are designed to improve core strength and endurance. Researchers have examined core activation doing spinal stabilization exercises on the premise that exercises requiring greater electromyographic (EMG) activity will benefit these patients. More limiting data exist for EMG activity during yoga postures. Moreover, males and females participate in yoga and it is unknown if between-sex differences exist during yoga postures. PURPOSE: The purpose of this study was to compare trunk and hip muscle EMG activity during yoga postures between males and females. METHODS: Fifteen healthy males and 15 females with less than 4 weeks of yoga experience participated. Surface electrodes were donned on the rectus abdominis (RA), abdominal obliques (AO), lumbar extensors, and gluteus maximus (GMX). Subjects performed the following postures: Chair, High Plank (Plank), Upward-Facing Dog, and Dominant-Side Warrior 1 (Warrior). They held each pose for a 20-s period and the last 15 seconds of data were used for statistical analysis. Data were expressed as 100% of a maximal voluntary isometric contraction. RESULTS: Females generated greater RA, OA, and GMX activity than males during the Plank. They also generated greater RA activity than males during the Warrior. No other between-sex differences existed for the other postures. CONCLUSION: Our results showed that males and females generated different levels of EMG activity during some of the yoga postures. Clinicians can use these findings for the development and implementation of sexspecific yoga prescription.

**Yoga Posture Analysis using a 3D Room Sensor for Cardiac and other Special Populations**

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Many innovative information technology applications use gestures as input. We are exploring gesture analysis for incorporation into exergames for personalized medical interventions using yoga as therapy (YT). PURPOSE: The research goal is to test whether a machine-learning algorithm in a basic computer video exergame can assess yoga skill acquisition in targeted select populations as a means to promote healthy physical activity. METHODS: A Kinect attached to a PC recorded a convenience sample of 20 male and female adult students of any race/ethnicity while performing a specific set of five instructor demonstrated yoga postures. Three yoga sessions (pre-test, mid-way and post-test) were captured during a regularly scheduled yoga class which met twice weekly for 75 minutes, over a 10-week period.
We recorded six yoga instructors performing a series of five yoga postures as the “gold standard”. The recorded clips that defined a yoga gesture were tagged or labeled by the consensus of two yoga researchers. Default settings produced solutions with high True Positives (99.5%) and low False Positives (0.03%) for most yoga postures sampled. We conducted an analysis of summary statistics for 20 participants comparing initial, mid-session, and final session captures. The depth stream and skeleton coordinates were analyzed against the training set. Sensitivity showed consistent trends for Mountain, Forward Bend, and Upward Salute. For Mountain, Sensitivity went from 0.78 to 0.87, while the expert test clip scored 0.94. Informedness also showed similar consistent trends for those poses. Based on these results the higher sensitivity score predicted training. CONCLUSIONS: Gesture analysis for yoga alignment training may be a useful tool for the development of home and clinical yoga therapy for hard to reach populations. The experimental exergame developed here provides a tool that scores the performance of yoga postures and provides improvement metrics. Our plans are to study the use and acceptance of this yoga exergame as an alternate therapy for hard to reach heart failure and other cardiac rehabilitation patients.

This study was funded by the College of Education, University of North Georgia, GA, USA

Resident Wellness Program Initiative: Yoga Classes During Didactics

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Surgical residency programs are well known for rigorous training and increasing rates of physician burn out. PURPOSE: To determine the feasibility of introducing yoga classes during didactics and the impact of a wellness program on stress, anxiety, depression, burn out and sleep. METHODS: We conducted a QI initiative consisting of an 8-week wellness program for 24 Ob-gyn residents and 5 Maternal- Fetal Medicine (MFM) fellows. The program consisted of weekly one hour yoga classes, nutritional and physical challenges. Surveys including the Maslach’s burnout inventory, the Five Faceted Mindfulness Scale (FFMS), the Pittsburgh Sleep Quality Index (PSQI), and the Depression Anxiety Stress Scale (DASS-21) were collected before and after the program. Objective improvement in physical well-being was assessed by blood pressure, heart rate, weight, and BMI. RESULTS: Over an 8-week period, 89.6% (n=26) participated in at least 1 yoga class. None of the participants completed all 8 sessions. Seventy percent (n=20) participated in at least 1 nutritional challenge and 51.7% (n=15) in at least 1 physical activity challenge. There was a statistically significant decrease in systolic (p=0.001) and diastolic blood pressure (p=0.008) after the program. A significant reduction in depersonalization (p= 0.043) was obtained. According to the DASS-21 scale, there was a statistically significant reduction in anxiety (p= 0.019) and a non-statistically significant improvement in stress and depression (p = 0.083 and 0.471 respectively). A significant improvement in mindfulness observation (p=0.019) was seen. CONCLUSIONS: Implementing a wellness program during protected didactic time is feasible. Despite limitations in attending classes regularly, participants experienced a decrease in depersonalization and anxiety, with some improvement in certain aspects of mindfulness. A resident wellness initiative that emphasizes active participation during didactics with the autonomy to implement wellness into daily activities has the potential to reduce physician burnout and improve well-being.

The Meaning of “Now” Moments of Engagement in Yoga for Persons with Alzheimer’s Disease

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Lakshmi Voelker Chair Yoga (LVCY) provides an alternative approach for people who cannot practice traditional yoga on a mat. This type of chair yoga can be adapted to meet the needs of people with physical and mental limitations, such as Alzheimer’s disease (AD). LVCY is based Raja yoga (yoga of mental and spiritual mastery) and hatha yoga (yoga of physical postures and breathing) that are adapted to sitting in a chair. Validation therapy (VT) is a form of verbal and nonverbal empathetic communication used to enhance quality of life for persons with AD.
PURPOSE: The purpose of this qualitative study was to explore the meaning of a multisensory LVCY program infused with VT for persons with AD living in three assisted living community homes. METHODS: Twenty-six individuals (ages 69 to 98), 19 females and 7 males, participated in a ten-week LVCY, twice a week for 30-55 minutes. Narrative progress notes, audio-visual images, and emails with caregiver and family feedback were analyzed using a grounded theory approach. RESULTS: From the findings a core category, ‘Personalized “Now” Moments of Engagement,’ was generated with three overarching sub-categories: (a) impact of characteristics and stages of AD, (b) VT concepts aided in multisensory design and LVCY format, and (c) increased engagement and verbal/nonverbal expression. In addition, ‘meaningful discovery by family and caregivers’ noted perception changes about the residents and increasing joy. CONCLUSION: Findings indicate that LVCY infused with VT can foster an effective treatment to improve quality of life for persons with AD, their families, and caregivers.

Yoga Meditation (YoMed) and its effect on proprioception and balance function in elders who have fallen: A randomized control study

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Yoga has been shown to improve muscle strength, flexibility, and balance. However, the impact of meditation on dynamic factors such as gait, reactive balance and proprioception has yet to be examined. PURPOSE: The purpose of this study was to test if a novel yoga meditation program (YoMed) is as effective as a standard proprioceptive training in improving proprioception, balance and power in older individuals who have fallen. METHODS: Sixteen older persons were randomly assigned to one of two training interventions; YoMed Group (YM) or Proprioception Training Group (PT). Each group received 45 minutes of specified training, 3 days per week, for 6 weeks. Pre- and post-training outcome measures were used to quantify the comparative effects of the interventions. Measurements taken included; The Balance Error Scoring System (BESS), the Tenetti Balance and Gait Assessment, dynamic posturography, joint position sense, and joint kinesthesia. RESULTS: The primary findings of the study were that neither the YM or PT intervention groups showed statistical improvements in any variable with the exception of the dynamic posturography overall score (DMA), which showed a significant improvement by the YM group (d = 1.238; p = 0.049). Additionally, changes in a number of variables that did not reach significance demonstrated effect sizes in the medium to high range. CONCLUSION: These results indicate the potential for the YoMed program to be used as a clinical intervention in older individuals. Given these results a longer study using a larger sample size and individuals at higher risk of falling is warranted.

This study is currently published in Complementary Therapies in Medicine 36 (2018) 129-136