Yoga-based Programs for Cardiovascular Disease, Diabetes, and related Chronic Conditions. Time for a New Health Care Paradigm?

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OVERVIEW

- Multimorbidity: Need for new paradigm
- Logistical Benefits of Yoga
- Yoga for common age-related conditions
  - CVD, diabetes & risk factors
  - Alzheimer’s disease (‘Type 3 Diabetes’) and Osteoarthritis
- Possible mechanistic pathways
- Directions for future research
Multimorbidity: The Coming Scourge

- **Chronic disorders**: main challenge for HC systems and populations worldwide

- **Multimorbidity** (2+ co-occurring chronic conditions):
  - Prevalence rising rapidly, coincident with:
    - Unprecedented aging of population
    - Increasing obesity, adverse changes in lifestyle
  - Current estimates: 40->85% of older adults
  - Prevalence in younger populations also high and rising
  - Linked to ↑ mortality, ↑ disability; ↑ functional impairment, ↓ QOL, ↑ use of inpatient and outpatient care
Chronic Disease Prevention & Management: Need for New Paradigm

- Most with chronic disorder have ≥ 2 conditions
- Chronic conditions tend to occur in clusters involving multiple organ systems
- Current approaches focus on specific organ systems/diseases often without considering dynamic interrelationships among many chronic disorders and their risk factors

More holistic, integrated approaches needed!

YOGA: A promising multi-faceted therapy?
Yoga: Background

- Mind-body discipline originating 4,000+ y ago
- Growing popularity worldwide
- Logistical advantages
  - Economical, non-invasive, no side effects
  - Simple to learn, can be practiced by elderly, unfit, or ill
  - Immediate positive benefits
  - Acceptable to a range of age, SES, and ethnic groups
Yoga for the Prevention and Management of Cardiovascular Disease (CVD) and Diabetes: Quick Review of the Literature
Background

- **CVD is the leading cause of death**
  - Prevalence risen dramatically worldwide
  - Parallel adverse changes in obesity, lifestyle

- **CVD risk:**
  - Rises sharply with menopause
  - Further increased in persons with T2 diabetes

- **Increased risk likely due in part to:**
  - Coincident rise in constellation of atherogenic changes linked to metabolic syndrome
  - Associated neuroendocrine and psychosocial alterations

*These changes inter-related and synergistic*
Figure 1. Factors associated with the development and progression of type 2 diabetes and CVD

*IRS=Insulin Resistance or Metabolic Syndrome

Yoga for CVD and Diabetes prevention and management?

- Yoga may offer a promising holistic therapy for helping to address the multiple, interrelated factors underlying CVD, T2 diabetes (DM), and related complex chronic disorders.
Effects of Yoga-based Programs on CVD/Diabetes Risk Profiles and Clinical Outcomes: Findings from Clinical Intervention Trials (N=147, 1970-2014)
Study Selection

► Inclusion Criteria:
► English language, 1970-present, original research
► Published papers in peer-reviewed scientific journals
► Assess effects of yoga-based programs on CVD risk or on clinical outcomes (CVD, DM2) in adults:
  ► Insulin resistance/glucose tolerance; lipids; blood pressure
  ► Body weight/composition; oxidative stress; blood clotting; inflammation
  ► Markers of sympathetic activation/parasympathetic function
  ► Clinical outcomes (CVD, DM2)

► Exclude:
► Case and cross-sectional studies, <7 participants/group
► Studies assessing change over single session
► Studies evaluating only TM or MBSR
Yoga and Conventional Risk Factors for CVD and DM2

Summary of Findings
Yoga and Conventional Risk Factors

Lipid profiles

- **45/51** studies report improvement
- **Reported Changes:**
  - **↓ Total cholesterol (6-25%)**
    - MD: -13.1 mg/dL (vs. UC)*
  - **↓ LDL (5-17%)**
    - MD: -10.3 mg/dL (vs. UC)*
  - **↓ VLDL**
    - MD: -5.7 mg/dL (vs. UC)*
  - **↓ Triglycerides (9-28%)**
    - MD: -21 mg/dL (vs. UC)*
  - **↑ HDL (4-33%)**
    - MD: +3.7 mg/dL (vs. Exercise)*

MD = mean difference

*RCT’s (Cramer et al, 2014. Int J Cardiol, in press)
Yoga Effects on Lipid Profiles
Nagarathna et al, 2012* (RCT, N=277 T2 DM)

Change in LDL levels

Change in HDL levels

Yoga and Conventional Risk Factors, cont.

- **Glucose tolerance:**
  - 56/63 studies report improvement
  - **Reported Changes:**
    - ↓ Fasting glucose (4-34%),
      - MD: -25.6 mg/dl (T2DM: vs. UC)*
    - ↓ Insulin resistance
      - MD: -0.2 (HOMA) (vs. UC)*
    - ↓ Post-prandial glucose (10-33%)
    - ↓ HbA1c (13-27%)
      - MD: -0.5 (vs. UC)*
    - ↓ Fructosamine (16%)

MD=Mean difference  UC=Usual care

*RCT’s (Cramer et al (2013). *Int J Cardiol, in press*).
Yoga effects on blood sugar
L Gordon et al, 2008* (RCT, N=231 DM 2)

Change in Fasting Blood Glucose (mg/dL)

Blood pressure

- **65/75** studies report improvement

**Reported Changes:**

- **↓ Systolic BP (3-21%):**
  - - 4-8 mmHg (preHT, HT)\(^1\)
  - - 6 mmHg (non-DM high risk: -10 mmHg) vs. UC\(^2\)

- **↓ Diastolic BP (4-24%):**
  - - 4-6 mmHg\(^1\)
  - - 4 mmHg (vs. UC)\(^2\)

\(^1\)Hagins et al, *eCAM*, 2013:649836
\(^2\)RCT’s (Cramer et al, *Int J Cardiol*. 2014
*doi: 10.1016/j.ijcard.2014.02.017*)
Yoga effects on blood pressure

*R Murugesan et al, 2000* (RCT, N=33 HT)

**Change in systolic blood pressure over time**

*Ind J Physiol Pharm.* 44: 207-210  
HT=Hypertensive
Body weight & composition

- **50/59** studies report improvement
- **Reported Changes:**
  - ↓ **BMI, % body fat**
  - ↓ **Weight (2-18%)**
  - ↓ **Waist circumference**
    - MD: -2.0 cm (vs. UC)*
  - ↓ **WHR**
    - MD: -0.02 (vs. UC)*


Emerging Risk factors

Growing evidence that yoga may:

- Reduce oxidative stress
  - 15 studies: 10 controlled (6 RCT)

- ↓ Inflammation
  - 6 studies: 4 controlled (3 RCT)

- Improve coagulation profiles
  - 4 studies: 2 controlled (non-randomized)

- ↓ Sympathetic activation, ↑ parasympathetic function
  - 48/51 studies: 30 controlled (17 RCT)
  - Changes: ↓Catecholamines, Cortisol, CV reactivity/recovery from stress (HR, BP); ↓ Resting HR, RR; ↑ HRV

- Decrease stress, enhance mood, improve sleep
Yoga and Clinical Outcomes

25/26 studies reported improvement
- Incl. 14/15 controlled (9/10 RCT)

Observed changes include:
- ↓ Medication need (Diabetes, CAD, hypertension)
- ↓ Episodes of Angina and Atrial fib
- ↓ Carotid intimal medial thickness
- ↓ Revascularization-related procedures
- ↓ Tx for other CVD-related complications
- ↓ Number serious coronary events
- ↓ Number hospitalizations
- ↓ Progression, ↑ regression of CAD lesions
Yoga for the Prevention & Management of CVD and Diabetes

Collectively, findings suggest that:

- Yoga may offer a safe, potentially cost-effective intervention for those with/at risk for CVD, T2 diabetes, and related chronic disorders

- But large rigorous controlled studies needed, esp in Western populations
Yogic Practices for Alzheimer’s Disease/Cognitive Impairment, OA

A New Therapeutic Approach?
Yogic Practices for AD/Cognitive Impairment

Background

- Alzheimer’s Disease (AD)
  - Most common form of dementia
  - Affects over 35 million adults, increasing rapidly
  - Affects health and quality of life for both the patient and the caregiver in profound ways
  - Linked to CVD, DM, obesity, HT, & related disorders + depression/anxiety, life stress, & sleep impairment

- Treatment options few: No cure and no effective interventions for preventing/slowing cognitive decline.
Background, cont.

- Yoga/Meditation: Safe, cost-effective intervention for those with and at risk for cognitive impairment?
  - While research remains relatively sparse=>
    - Findings of studies in both cognitively impaired and non-impaired adults are promising!
Yoga/meditation for Preventing/slowing Cognitive Decline

**Studies:**

**Cross-Sectional** in healthy adults (N=12):

- Experienced meditation practitioners vs. controls
  - Significant differences, with M group showing:
    - ↑ Cortical thickness
    - ↑ Grey matter volume, density
    - ↑ Cerebral blood flow to key brain regions
    - ↑ Cognitive function, efficiency
    - **No/↓** age-related decline

**Clinical trials** (N=14)

- Healthy adults (N=5, 2 NRCT, 3 RCT)
- Depressed adults/dementia caregivers (N=3 RCT); T2DM (1 NRCT)
- Cognitively impaired adults (N=5, 2 NRCT, 1 RCT)
Yoga/meditation for Preventing/slowing Cognitive Decline: Clinical Trials, cont.

Findings suggest yogic practices may:

- Improve brain structure and function
  - ↑ Cerebral blood flow in areas linked to attention, memory, executive & autonomic function
  - ↑ Cortical thickness; ↑ grey matter density/volume*
  - ↑ Structural connectivity*

- Improve memory/cognitive performance
  - Healthy (N=3/4)
  - Depressed/caregivers (N=2/2), T2DM (1/1)
  - Cognitively impaired (N=2/2)

*MBSR
Yoga/meditation for Preventing/ slowing Cognitive Decline

Other related beneficial changes:

- Improved stress-related genomic indices of inflammation, immune function; cellular aging
  - Dementia caregivers (N=1/1)

- Improved mood, sleep, QOL; ↓ stress, anxiety
  - Depressed older adults/caregivers (N=2/2)
  - Adults with cognitive impairment (N=2/2)

- Reduced sympathetic activation (↓ BP)
  - Adults with cognitive impairment (N=1/1)

- Enhanced physical function
  - Adults with cognitive impairment (N=1/1)
Yoga/meditation for Preventing/slowing Cognitive Decline

Collectively, findings suggest that:

- Yogic practices may help reduce stress- and age-related risk factors for Alzheimer’s Disease; improve brain structure & function, cognitive performance, and memory; and possibly slow/prevent cognitive decline.

- But studies remain few, and larger, rigorous trials in those with memory loss, esp early memory loss are needed!
Yogic Practices for Osteoarthritis (OA)
Yogic Practices For Osteoarthritis (OA): Background

Osteoarthritis (OA)
- A leading cause of disability among adults
- Linked to: CVD, DM, obesity, inflammation, sympathetic activation, mood/sleep problems
- Current (pharmacologic) treatments
  - Often ineffective, not suitable for long term use
  - Can have serious side effects
- Yoga/Meditation: A promising therapeutic approach?
  - Reported to improve outcomes in other chronic pain syndromes
Yogic Practices For OA: Potential Benefits

Studies few but findings promising

- **8-12 wk therapeutic yoga and meditation programs*** (7 trials, 3 RCTs) *shown to:*
  - ↓ Pain, tenderness, stiffness, medication use
  - ↑ Function, range of motion, walking speed
  - Improve mood, sleep, QOL; ↓ stress
  - ↓ Blood pressure, heart rate

*Incl. chair, viniyoga, iyengar, ‘integrated’ yoga; mantra meditation
Yogic Practices For OA cont

Findings of most studies suggest

- Multiple benefits for those with OA
- Effect sizes comparable or superior to those of commonly used medications

But

- Most studies small, uncontrolled⇒
- Larger, high quality trials needed!
In sum, these studies suggest that yoga-based programs may provide an attractive, feasible and beneficial intervention for the prevention and management of CVD, diabetes, cognitive impairment, OA, and other chronic disorders linked to autonomic and metabolic dysregulation.

If effective, use of yoga in prevention & management of these and related conditions could significantly reduce health care costs & lost productivity due to these disorders.
Web of Chronic Disease

- Depression
- Anxiety
- Insomnia, Sleep Disorders
- Diabetes
- Arthritis
- Physical disability
- ANS & Metabolic dysregulation
- CVD
- Dementia
Possible pathways by which yogic practices may reduce risk for CVD, type 2 diabetes, and related conditions

Pathway 1: Improved Sleep
- ↓ Activation/reactivity of sympathoadrenal system and HPA axis
- Vagal stimulation
- ↑ Parasympathetic Function
- ↓ Perceived stress
- ↑ Physical Function

Pathway 2: Improved Metabolic profile
- ↓ Insulin resistance/↑ Glucose tolerance
- ↓ Dyslipidemia
- ↓ Obesity
- ↓ Risk: CVD, DM2, and related disorders

Pathway 3: Selective activation of specific brain structures & neurochemical systems → Positive changes in brain structure and function
- ↑ Mood
- ↓ Pain
- ↑ Physical Function

Pathway 4: Improved Blood pressure
- ↓ HRV
- ↓ Inflammation
- ↓ Blood pressure
- ↓ Heart rate
- ↓ Perceived stress
- ↓ Inflammation
- ↓ Blood pressure
- ↓ Heart rate
- ↑ Vagal stimulation
- ↑ Parasympathetic Function
- ↓ Perceived stress
- ↑ Physical Function
- ↑ Mood
- ↓ Pain
- ↑ Physical Function

↓ Risk: CVD, DM2, and related disorders
Directions for Future Research
Future Research Needs

- **Large, rigorous, well-designed trials, clear, replicable protocols**
- Long term follow-up and maintenance studies
- Research regarding specific direct clinical markers, emerging risk factors, and underlying mechanisms
- ‘Dosing’ and comparative intervention studies
- Community-based/translational studies
- Cost-effectiveness studies
- Increased collaboration among researchers, yoga therapists, and health care providers
Yoga-based programs for CVD, DM, & related chronic conditions: What does the research tell us?

Promising findings from rapidly growing field:

- Suggest yoga may be effective in addressing multiple, inter-related risk factors underlying a number of common chronic disorders.

- Underscore value of approaching chronic disease management from ecological vs. organ, disease, single sign/symptom-specific perspective.

The holistic approach to health & wellness intrinsic to yoga therapy may presage a new paradigm for health care.
Evolution of Man (and Woman)

5 million years ago

2 million years ago

80 thousand years ago
Evolution of Man (and Woman)

5 million years ago

2 million years ago

80 thousand years ago

Present
Evolution of Man (and Woman)

5 million years ago
2 million years ago
80 thousand years ago
Present
Future?
Yoga-based Programs for Cardiovascular Disease, Diabetes, and related Chronic Conditions. Time for a New Health Care Paradigm?

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Limitations in Current Research

- Under-representation in certain populations
- Few studies in adults with OA, CI, RLS, etc
- Methodologic & other limitations: E.g.,
  - Small sample sizes
  - Subject selection bias/Inadequate comparison groups
  - Non-random treatment assignment
  - Inadequate blinding
  - Multimodal or non-standardized interventions
  - High/differential attrition/Poor adherence
  - Statistical issues
  - Reporting problems: Incomplete/unclear/imprecise
    - Study population, participant selection, study design, intervention/control, tx allocation, statistical analysis, etc.
Yoga Effects on Indices of Obesity

Manchanda et al, 2013* (RCT, N=100 Met Syn)

Effects of yoga on emerging CVD risk factors

Growing evidence that yoga may:

- **↓ Oxidative stress: 15 studies**
  - 5 UCT, 4 NRCT, 6 RCT (5 DM, 7 CVD/other, 3 healthy)
  - Improved anti-oxidant status, ↓ markers of oxidative stress (TBARS, MDA, SOD+)

- **Improve coagulation profiles: 4 studies**
  - 2 UCT, 1 small RCT (healthy), 1 NRCT (CVD/CVD risk)
  - ↓ fibrinogen, ↑ fibrinolytic activity, platelet aggregation time, platelet number

- **↓ Inflammation: 5 studies**
  - 3 UCT (obese, other), 1 NRCT (Cancer pts), 1 RCT (Heart failure pts)
  - ↓ hsCRP, proinflammatory cytokines (TNF-alpha, IL-6+)
Yoga effects on inflammation

PR Pullen et al, 2008* (RCT, N=19 Heart Failure)

**IL-6 (mg/dL)**
- **Yoga**
- **Control**

**hsCRP (mg/dL)**
- **Yoga**
- **Control**

*J Card Fail 14:407-413
HF=Heart failure
Multimorbidity and age*

Yoga for Other Related Disorders

Restless Legs Syndrome
Yoga for Restless Legs Syndrome (RLS)  

**Background**

**RLS:**
- Common and burdensome sleep disorder
- *Linked to increased risk for CVD and stroke*
- Profound effects on mood and sleep
- Leads to reductions in QOL comparable to other serious disorders

**Characterized by**
- Compelling, unrelenting urge to move legs
  - Usually with unpleasant sensations
  - Worse at rest and in evening/night
  - Relieved by movement
Yoga for Restless Legs Syndrome (RLS) 

Background

RLS:
- Common and burdensome sleep disorder
- Linked to increased risk for CVD and stroke
- Profound effects on mood and sleep
- Leads to reductions in QOL comparable to other serious disorders

Characterized by
- Compelling, unrelenting urge to move legs
  - Usually with unpleasant sensations
  - Worse at rest and in evening/night
  - Relieved by movement
Yoga for Restless Legs Syndrome (RLS)  
Background, cont.

- **Etiology poorly understood:**
  - Associated with conditions characterized by:
    - Sympathetic overactivity and metabolic dysregulation
      *Including:*
      - CVD, diabetes, hypertension, obesity, arthritis, & related conditions

- **No cure for RLS**

- **Existing pharmacologic treatments**
  - Aimed at symptom reduction
  - Not always effective, often offer only short term relief
  - Serious side effects

*Investigation of other therapies needed*
Yoga: A Promising Alternative for RLS Suffers?

• Growing evidence that yoga may be helpful for conditions linked to RLS

• Relaxation and other lifestyle/behavioral practices, *including yoga*, often recommended

  ▪ *BUT* guidelines remain non-specific, research sparse

  =>>

  ▪ Yoga for RLS: Two pilot studies
Yoga for RLS: Pilot Studies

1) Controlled trial in older women with RLS*

- Overweight, sedentary, postmenopausal women
- Randomized to yoga (N=10) or educational film (N=10)
- Yoga group: Improvement vs. controls in:
  - Sleep Quality and prevalence of insomnia (p’s<0.01, Effect Size (ES)=2.6)
  - Mood, Perceived Stress (p’s<0.02, ES=2-2.5)
  - Anxiety (p=0.002, ES=1.9)
  - Systolic Blood Pressure (p=0.05, ES=1.3)
  - Diastolic blood pressure (p<0.03, ES=0.9)

Effects of a Gentle 8 week Yoga Program for Women with RLS

2) Preliminary study in women with RLS*

- 13 women with moderate to severe RLS
- Complete 8 week Iyengar yoga program
- Striking improvement post-treatment in:
  - RLS symptoms (p’s<0.01, ES 1.6-2.2)
    - Decline with ↑ home practice
  - Sleep problems (MOS) (p<0.0004, ES=1.3-1.6)
  - Perceived Stress, Mood (p’s<0.02, ES=1.0)

Conclusions

Yoga may help decrease RLS symptoms, improve sleep, enhance mood, reduce stress and anxiety, and decrease blood pressure in women with RLS.
Yoga/meditation for Preventing/slowing Cognitive Decline

**Studies:**

**Cross-Sectional** in healthy adults (N=12):
- Experienced meditation practitioners vs. controls
  - Suggest meditation may:
    - ↑ Cortical thickness
    - ↑ Grey matter volume, density
    - ↑ Cerebral blood flow to key brain regions
    - ↑ Cognitive function, efficiency
    - ↓/ Eliminate age-related decline

**Clinical trials** (N=14)
- Healthy adults (N=5, 2 NRCT, 3 RCT)
- Depressed adults/dementia caregivers (N=3 RCT); T2DM (1 NRCT)
- Cognitively impaired adults (N=5, 2 NRCT, 1 RCT)
Yoga: A safe, cost-effective strategy for reducing risk for CVD/diabetes?

- Promising holistic therapy for addressing the multiple, interrelated factors underlying CVD, T2 diabetes (DM), and related chronic disorders
- Growing evidence that yoga may reduce CVD/DM risk and improve clinical outcomes