

# Research

## Group-Based Yogic Weight Loss with Ayurveda-Inspired Components: A Pilot Investigation of Female Yoga Practitioners and Novices

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### Abstract

**Introduction:** Overweight/obesity is a pressing international health concern and conventional treatments demonstrate poor long-term efficacy. Preliminary evidence suggests yoga and Ayurveda may be promising approaches, although recent NHIS estimates indicate rare utilization of Ayurveda in the US. Group-based curricula that integrate yoga and Ayurveda-inspired principles to attenuate overweight and obesity across individuals may prove a feasible, disseminable clinical adjunct to facilitate psychosocial health and weight loss and/or maintenance. **Aims:** Determine feasibility and preliminary effectiveness of a ten-week yoga-based, Ayurveda-inspired weight management curriculum (YWL) piloted in female yoga practitioners (Study 1) then refined and tailored for yoga naïves (Study 2), on self-reported psychosocial process variables and % of self-reported total body weight loss (%TBWL). **Methodology:** Study 1 enrolled 22 yoga-experienced women ( $48.2 \pm 14.3$  years, BMI  $30.8 \pm 4.2$  kg/m<sup>2</sup>) in a 10-week yoga-based program (YWL-YE). Study 2 enrolled 21 yoga-naïve women ( $49.4 \pm 10.7$  years, BMI  $35.5 \pm 6.8$  kg/m<sup>2</sup>) in a revised 10-week program (YWL-YN). Self-reported weight and self-ratings of mindful eating behavior, body image disturbance, weight loss self-efficacy, body awareness, and self-compassion were collected at baseline, post-treatment (T2), and 3-month follow-up (T3). **Results:** YWL curricula was feasible in both studies. While attrition rates for both studies favorably compared to other weight management studies, attrition was higher for YWL-YN (28.6%) than YWL-YE (18.2%). In both studies, self-reported process variables and self-reported % TBWL changed in hypothesized directions at T2 and evidenced greater improvement at T3; effect sizes

across all process variables were medium (-0.4) to large (-1.8). %TBWL reached clinical significance (>5%) only at T3 for the YWL-YE group. **Conclusions:** The YWL curricula employed here appear to improve psychosocial health among both overweight/obese yoga-experienced and yoga-naïve women. Results must be interpreted with caution due to study design, self-report assessments, and other limitations. Nonetheless, hypotheses are generated for future investigation.

**Keywords:** Yoga, Ayurveda, obesity, weight loss, mindfulness, self-compassion

### Introduction

Overweight and obesity are at epidemic levels in the United States, with projected global increases to nearly 40% by 2030 (Wang, McPherson, Marsh, Gortmaker, & Brown, 2011). Prevailing treatment approaches have largely shown poor long-term efficacy (Brownell, 2010; Jones, Wilson, & Wadden, 2007), demonstrating the need for novel approaches that target obesity's multi-factorial etiology and represent a useful adjunct to the clinical standard of care. We present two studies exploring feasibility and preliminary outcomes of a yoga- and Ayurveda-inspired weight management curriculum (YWL) in two samples of overweight women.

### Yoga

Yoga is an integrative spiritual practice that developed in ancient India. "Yoga" means to "yoke," i.e., conjoin body, mind, and spirit (Desikachar, 1999), and is the most commonly utilized complementary and alternative medicine (CAM) approach for weight loss in the United States

(Sharpe, Blanck, Williams, Ainsworth, & Conway, 2007). Intervention research suggests yoga may be a valuable tool in the arsenal against obesity (Rioux & Ritenbaugh, 2013), while observational data has linked yoga practice to lower BMI, attenuated weight gain, and improved dietary and exercise behaviors (e.g., Framson et al., 2009; Kristal, Littman, Benitez, & White, 2002; Moliver et al., 2011). Yoga interventions have been shown to improve general self-efficacy (Dunn, 2010), mindfulness (Conboy, Wilson, & Braun, 2010; Shelov, Suchday, & Friedberg, 2009), stress (Ross & Thomas, 2010), and self-compassion (Braun, Park, & Conboy, 2012; Gard et al., 2012), and cross-sectional studies link yoga practice to greater body awareness (Daubenmier, 2005) and mindful eating (Framson et al., 2009). These constructs may synergistically improve obesity-related parameters and may represent potential mechanisms or process variables through which yoga may facilitate weight loss and maintenance.

Kripalu Yoga, used in the YWL tested here, underscores yoga's accessibility to all bodies and persons. "Kripalu" is defined as "compassionate" or "merciful" in Sanskrit and emphasizes yoga "off the mat," referring to the importance of applying these and other qualities, such as mindfulness, to lived experience. This application is accomplished through Kripalu's experiential approach to facilitating behavior change, riding the wave (Faulds, 2005). Similar to the cognitive-behavioral technique urge surfing but incorporating mindfulness, embodiment, and breathing exercises, this method refers to riding the waves of difficult sensation (e.g., food cravings, yoga pose) without "jumping off" to engage in habitual coping strategies (e.g., overeating, coming out of the pose; Braun et al., 2012). Kripalu Yoga also occasionally incorporates social support in the form of sharing in dyads or as a group, a practice shown to improve weight management outcomes (Parham, 1993).

### Ayurveda

India's indigenous system of medicine, Ayurveda, combines the Sanskrit words *ayur* (life) and *veda* (science or knowledge) to mean "the science of life" (Smith & Wujastyk, 2008). To prevent illness and promote wellness, Ayurvedic medicine aims to integrate and balance body, mind, and spirit. Ayurveda relies on in-depth observation of the relationship between environmental (external) and internal processes, and employs a number of individualized techniques and practices to maintain and restore balance (Frawley, 2000).

The Ayurvedic texts *Charaka Samhita* and *Sushruta Samhita* offer a rich formulation for obesity's etiologies and treatment (Shastri, 2003 and Shastri & Chaturvedi, 2004, as cited in Sharma & Chandola, 2013), and several studies suggest that Ayurvedic medical treatment of obesity may

prove effective (e.g., Joshi, Deole, Viyas, & Dash, 2009; Ramen, Tripathy, Mallika, Shivakumar, & Kavita, 2013; Sharma, Puri, Agarwal, & Sharma, 2009), including a recent intervention trial that piloted a whole system (i.e., individually tailored) Ayurvedic protocol among overweight and obese individuals (Rioux, Thomson, & Howerter, 2014). Despite these promising outcomes, reflecting the comparatively recent introduction of Ayurveda to the United States, fewer individuals have reported obtaining Ayurvedic treatment than other CAM modalities, with prevalence rates remaining constant in the 2002, 2007, and 2012 National Health Interview Surveys (NHIS; Clarke, Black, Stussman, Barnes, & Nahin, 2015).

Ayurveda has shared cultural roots with yoga, which has enjoyed substantial increases in United States prevalence from 5.8% in 2002 to 10.8% in the 2012 NHIS (Clark et al., 2015). Modern forms of yoga practiced in the United States and increasingly globally are more exercise-based and bear little resemblance to traditional forms of Indian yoga, a departure that may contribute to their popularity (Askegaard & Eckhardt, 2012). Adaptation of other indigenous practices for use with Western populations that may otherwise resist foreign spiritual or cultural concepts has precedent in the modern operationalization of yoga, mindfulness (Buddhism), and acupuncture (Traditional Chinese Medicine) practices. While such adaptations have been appropriately termed a form of cultural appropriation or watering down (Askegaard & Eckhardt, 2012)—consider, for example, the term "New Age Ayurveda" (Smith & Wujastyk, 2008)—it has also been argued that evolution is critical for these practices to obtain widespread acceptability in novel cultural contexts (Conboy et al., 2009; Hammerschlag, 1998).

We propose that alongside continued assessment of traditional, personalized Ayurvedic medicine, investigation of Ayurveda-inspired principles posited to facilitate weight management and overall health across individuals (in contrast to Ayurveda's integral emphasis on personalization) is merited. Such "universal" principles are conceptualized as Ayurveda-inspired rather than Ayurveda, and may prove a feasible alternative or introduction to Ayurveda when integrated into mainstream healthcare or community settings adjunctive to standard of care for weight management. This approach is not intended as a substitute for Ayurvedic medicine but as a complement to and substantial departure from Ayurveda as it has been practiced in India.

### Objective

The current investigation sought to pilot the feasibility and preliminary effectiveness of two group-based yoga curricula incorporating Ayurveda-inspired principles in two samples of yoga-experienced and yoga-naïve women. Because yoga is

widely practiced in the United States (Clarke et al., 2015), embedding Ayurveda-inspired weight management principles in a yoga program was hypothesized to enhance the appeal of Ayurveda-inspired content. No study to date has assessed the feasibility of such curricula or assessed their preliminary effects on markers of psychosocial health and self-reported weight loss. To facilitate recruitment and minimize variance in this pilot project, we elected to recruit women due to the higher prevalence of female yoga practitioners (Birdee et al., 2008).

Study 1 piloted YWL in overweight, yoga-experienced women (YWL-YE) to optimize and streamline the program for yoga-naïve participants. Qualitative outcomes from Study 1 were used to inform the curriculum for Study 2, which implemented the revised intervention in overweight, yoga-naïve women (YWL-YN). Qualitative data collected from Study 2 will be reported in a separate publication.

Primary outcomes for both studies were feasibility. A secondary aim was to evaluate improvement in psychosocial process variables targeted by the interventions (i.e., mindful eating behavior, weight loss self-efficacy, self-compassion, body image, body awareness). Self-reported percentage of body weight lost at post-treatment and follow-up was assessed as a tertiary aim. Notably, self-reported weight loss is subject to recall errors and well-documented discrepancies exist between actual and reported weight among overweight and obese individuals, although this bias may be less common among women (Lois, Kumar, Williams, & Birrell, 2011).

## Materials and Methods

### Recruitment

Study procedures were approved by the New England Institutional Review Board ([www.neirb.com](http://www.neirb.com)). Study participants were recruited through advertisements in a Northeastern rural region of the United States. Recruitment materials and sites were slightly modified to target the different samples in Studies 1 and 2.

### Sample

Eligibility criteria for both studies included (1) female gender; (2)  $\geq 18$  years of age; (3) self-reported Body Mass Index (BMI)  $\geq 25$ ; (4) fitness to walk two miles at a moderate pace; (5) physician consent; and (6) non-participation in other weight-loss programs or techniques at the time of enrollment or for the duration of the study. For the purposes of the present study, yoga-experienced participants (Study 1) were defined as those who had practiced yoga at least once per week on average for the prior six months. Yoga-naïve participants (Study 2) were defined as having participated in fewer than four yoga classes in their lifetime.

### Procedures

Due to the preliminary and exploratory nature of these studies, a single-group design was used for each study.

### Data Collection

Study participants completed online surveys at baseline, post-treatment (10 weeks), and follow-up (three months after intervention cessation). At post-treatment and follow-up, participants who did not complete the first survey were emailed a second survey 7 days later and a third survey 14 days later.

### Interventions

Both interventions aimed to mitigate overweight/obesity using Ayurveda-inspired psychoeducation and lifestyle principles and Kripalu Yoga. The two 10-week interventions were designed and implemented by two trained Ayurvedic lifestyle practitioners and senior Kripalu Yoga instructors in consultation with the dean of an Ayurvedic training facility. Sessions were conducted onsite at a yoga training and retreat center, in a building separate from the main retreat environment.

Both interventions included twice-weekly two-hour workshop sessions (Table 1) and yoga sessions (Table 2), and a prescribed weekly home practice. In Study 1, YWL-YE comprised a 10-week, 14-session curriculum. During weeks 1 through 4, the intervention comprised twice-weekly, two-hour workshop and yoga sessions, respectively. In weeks 5 through 10, workshop sessions discontinued while yoga sessions continued (Table 3).

In Study 2, YWL-YN comprised a revised 10-week, 20-session curriculum (Table 3). Based on focus group feedback from Study 1, workshop sessions were expanded to twice weekly for 10 weeks (Table 1), with YWL-YN having 30% more contact hours than did YWL-YE. Revisions included better tailoring the yoga to more basic postures and modifications to serve larger bodies, more gradual introduction of postures, additional instructor assistance to participants during the yoga class, simplification of Ayurveda-inspired content, and repetition of yoga philosophy principles.

**Workshop sessions.** Workshop sessions comprised 30 minutes of gentle yoga and 90 minutes of lectures and experiential activities relating to Ayurveda-inspired and yogic theory and practices (Table 1). Ayurveda-inspired lifestyle guidelines and practices (Table 4) aimed to vitiate those elements Ayurveda often implicates as excessive in obesity (e.g., Sharma & Chandola, 2013). These guidelines primarily sought to mitigate imbalances in *kapha* (water/earth element), which generates increased physiological mass by various factors such as sedentary behavior or intake of energy-dense foods. A secondary goal was balancing *vata* (ether/air

### Study 1, YWL-YE

<u>Session</u>	<u>Didactic Components (minutes)</u>	<u>Experiential Components (minutes)</u>
1	Introduce: Program overview (10 m) Introduce: Ayurveda (30 m) Introduce: Kripalu yoga and riding the wave (15 m) Introduce: Self-compassion (SC), mindfulness (15 m) Introduce: Home practice (10 m)	Dasha chalana (gentle yoga, 30 m) Meditation (10 m)
2	Continue: Ayurveda <ul style="list-style-type: none"> <li>• Introduce: Macrocosm/microcosm (15 m)</li> <li>• Introduce: Doshas (biological constitution), Gunas (qualities of mind, 25 m)</li> <li>• Introduce: Ayurveda &amp; obesity (25 m)</li> <li>• Introduce: Dinacharya (Ayurvedic lifestyle guidelines, 5 m, Table 3)</li> </ul>	Dasha chalana (30 m)
3	Introduce: Mindful eating (20 m) Continue: Riding the wave (15 m) <ul style="list-style-type: none"> <li>• Introduce: Breathe Relax Feel Watch Allow (10 m)</li> </ul> Continue: SC, mindfulness (15 m)	Dasha chalana (30 m) Mindful eating of raisin (10 m) Yoga posture, sustained hold (10 m) Body scan, meditation (10 m)
4	Review: Ayurveda for weight loss (25 m) Review: Mindful eating (15 m) Review: SC, mindfulness (15 m) Review: Riding the wave (10 m)	Dasha chalana (30 m) Writing letter to body (25 m)

### Study 2, YWL-YN

<u>Session</u>	<u>Didactic Components</u>	<u>Experiential Components</u>
1	Introduce: Program overview <ul style="list-style-type: none"> <li>• Introduce: Ayurveda (40 m)</li> <li>• Introduce: Mindful eating (30 m)</li> <li>• Introduce: Kripalu yoga and riding the wave (15 m)</li> <li>• Introduce: Self-compassion (SC), mindfulness (20 m)</li> <li>• Introduce: Home practice (15 m)</li> </ul>	Posture clinic (60 m)
2	Introduce: Riding the wave to break the chain <ul style="list-style-type: none"> <li>• Introduce: Breathe Relax Feel Watch Allow (15 m)</li> <li>• Continue: SC, mindfulness, body awareness (10 m)</li> <li>• Introduce: Managing resistance/obstacles (15 m)</li> <li>• Introduce: Breaking the chain (10 m)</li> <li>• Demo: Sustained holding of yoga pose (10 m)</li> </ul>	Dasha chalana (30 m) Sustained yoga pose (10 m) Strategize barriers (10 m) Chaining exercise (10 m)
3	Continue: Ayurveda <ul style="list-style-type: none"> <li>• Introduce: Macrocosm/microcosm (15 m)</li> <li>• Introduce: Doshas, Gunas (15 m)</li> <li>• Introduce: Ayurveda &amp; obesity (25 m)</li> <li>• Introduce: Dinacharya (Table 3, 17 m)</li> <li>• Introduce: Sankalpas (intention setting, 10 m)</li> </ul>	Dasha chalana (30 m) Meditation (5 m) Commit to 2 dinacharya (3 m)

**Table 1. Workshop session components, by study.**

4	<p>Continue: Mindful Eating and riding the wave</p> <ul style="list-style-type: none"> <li>• Review: Eating/dietary guidelines (Table 3, 10 m)</li> <li>• Introduce: Motives for overeating (20 m)</li> <li>• Continue: Mindful eating (20 m)</li> <li>• Continue: Riding the wave (25 m)</li> </ul>	<p><i>Dasha chalana</i> (30 m) Meditation (5 m) Mindful eating of raisin (10 m)</p>
5	<p>Continue: Ayurveda</p> <ul style="list-style-type: none"> <li>• Review: <i>Doshas, Gunas</i> (15 m)</li> <li>• Review: <i>Dinacharya</i> (15 m)</li> <li>• Introduce: <i>Gunas</i> in foods (55 m)</li> </ul>	<p><i>Dasha chalana</i> (30 m) Meditation (5 m)</p>
6	<p>Integrate: Ayurveda, mindful eating, and riding the wave</p> <ul style="list-style-type: none"> <li>• Review: Eating/dietary guidelines (10 m)</li> <li>• Review: Mindful eating (10 m)</li> <li>• Review: Riding the wave (10 m)</li> <li>• Continue: <i>Gunas</i> in foods (25 m)</li> </ul>	<p><i>Dasha chalana</i> (30 m) Sustained yoga pose (15 m) Mindful eating (<i>Gunas</i>) (20 m)</p>
7	<p>Introduce: Media literacy, weight stigma, mindfulness, and SC</p> <ul style="list-style-type: none"> <li>• Review: Macrocosm/microcosm (5 m)</li> <li>• Introduce: Awareness of the impact of toxic mental environment (e.g., food ads) on eating behavior (30 m) <ul style="list-style-type: none"> <li>• Integrate: Mindfulness as buffer to psychological hunger (10 m)</li> </ul> </li> <li>• Introduce: Weight stigma and behavioral impact (15 m) <ul style="list-style-type: none"> <li>• Integrate: Self-compassion as buffer to self-judgment (10 m)</li> </ul> </li> </ul>	<p><i>Dasha chalana</i> (30 m) Meditation (5 m) Worksheet to identify maladaptive mental patterns (<i>samskara</i>) and develop SC and mindful alternatives (15 m)</p>
8	<p>Review &amp; Practice: Potluck</p> <ul style="list-style-type: none"> <li>• Review: Macrocosm/microcosm (5 m)</li> <li>• Review: Ayurvedic dinacharya (5 m)</li> <li>• Review: <i>Gunas</i> in food (15 m)</li> <li>• Review: Riding the wave (15 m)</li> <li>• Review: Mindful eating (15 m)</li> </ul>	<p><i>Dasha chalana</i> (30 m) Commit to 4 dinacharya (5 m) Mindful eating (potluck, trigger foods) (30 m)</p>
9	<p>Introduce: Dharma and intentions</p> <ul style="list-style-type: none"> <li>• Introduce: Dharma (duty or right livelihood; values, 10 m)</li> <li>• Introduce: Specific, Measurable, Achievable, Relevant, Time-bound (SMART) goals (10 m)</li> <li>• Continue: Managing resistance/obstacles (20 m)</li> <li>• Continue: Riding the wave (15 m)</li> </ul>	<p><i>Dasha chalana</i> (30 m) Worksheet to identify <i>dharma</i> (10 m) SMART worksheet (7.5 m) Wheel of life worksheet (7.5 m) Sustained yoga pose hold (10 m)</p>
10	<p>Conclusion</p> <ul style="list-style-type: none"> <li>• Sharing circle (40 m)</li> <li>• Q&amp;A (40 m)</li> <li>• Resources for continuation (10 m)</li> </ul>	<p><i>Dasha chalana</i> (30 m)</p>

Table 1. *continued.*

Study 1	Weeks 1–3	Weeks 4–6	Weeks 7–10
Centering and warm-up	Meditation on the breath, three-part breath ( <i>Dhirga Pranayama</i> ), ten churnings ( <i>Dasha Chalana</i> : rotations of ankles, knees, hips; standing pulsating twists; standing lateral bend pulsations; spinal undulations; wrist, shoulder, chin rotations; elbows touch and open with fingers on back of head), standing sun breaths	Meditation on the breath, three-part breath, victorious breath ( <i>Ujjayi Pranayama</i> ), gentle skull-polishing breath ( <i>Kapalabhati</i> ), ten churnings, breath of joy, standing meditation	Meditation on the breath; three-part, victorious, and skull-polishing breaths; ten churnings; standing meditation; pulses on breath between extended mountain and awkward pose twists
Standing postures	2x half sun salutations ( <i>Ardha Surya Namaskara</i> ); extended mountain [ <i>Urdhva Hastasana</i> ], standing forward fold [ <i>Uttanasana</i> ], half-standing forward fold [ <i>Ardha Uttanasana</i> ], standing forward fold, awkward pose [ <i>Utkatasana</i> ], extended mountain); 2x classical sun salutation (extended mountain, standing forward bend, extended forward bend, standing forward bend, low lunge [ <i>Ashva Sanchalanasana</i> ], plank, child's [ <i>Balasana</i> ], downward facing dog [ <i>Adho Mukha Savanasana</i> ], low lunge, standing forward bend, extended forward fold, standing forward fold, awkward pose, extended mountain), tree ( <i>Vrksasana</i> ), mountain, rag doll, plank	2x half sun salutations, 2x classical sun salutation, 1x sun salutation B (extended mountain, standing forward bend, extended forward fold, standing forward fold, low lunge, warrior 1 [ <i>Varabhadrasana I</i> ]; plank, four-limbed staff [ <i>Caturanga Dandasana</i> ], cobra/upward facing dog [ <i>Bhujangasana/Urdhvamukhanvanasana</i> ], child's, downward facing dog, low lunge, warrior 1, standing forward fold, extended forward fold, standing forward fold, awkward pose, extended mountain), 1x sun salutation B with warrior 2 ( <i>Varabhadrasana II</i> ) and goddess ( <i>Devi Asana</i> ), extended mountain, standing forward bend, extended forward bend, standing forward bend, runner's lunge, warrior 2, goddess, warrior 2, plank, cobra, upward facing dog, downward facing dog, child's, runner's lunge, warrior 2, goddess, warrior 2, standing forward bend, extended forward bend, standing forward bend, awkward pose, extended mountain), standing forward fold, plank	2x half sun salutations; 2x classical sun salutation; 1x sun salutation B with pulsing twists on the breath; 1x sun salutation B with warrior 2, lateral angle ( <i>Uttihita Parsvakonasana</i> ), reversed warrior ( <i>Viparita Virabhadrasana</i> ), and triangle ( <i>Trikonasana</i> ); 1x sun salutation B with transition on breath to modified warrior 3 ( <i>Virabhadrasana III</i> ); extended mountain; standing forward fold; extended forward fold; standing forward fold; rag doll

**Table 2. Yoga session content: Sequences of meditation, postures, and breathing practices across three phases of intervention. Not all practices were included in a single class but were included in a given phase.**

Seated, prone, and supine postures	Boat pose ( <i>Navasana</i> ), seated spinal twist ( <i>Ardha Matsyendrasana</i> ), knee-down seated spinal twist, supine half wind-relieving pose ( <i>Ardha Pawanmuktasana</i> ), knees to chest pose ( <i>Apanasana</i> )	Half locust pose ( <i>Ardha Salabhasana</i> ), boat pose, child's pose, head to knee forward fold ( <i>Janu Sirsasana</i> ), knees to chest pose	Table; half locust; boat; bow ( <i>Dhanurasana</i> ); child's; table; pigeon ( <i>Kapotasana</i> ); bridge ( <i>Sethubandasana</i> ); happy baby ( <i>Ananda Balasana</i> ); knee-down twist ( <i>Jathara Parivartanasana</i> )
Cool-down and centering	corpse pose ( <i>Savasana</i> ), alternate nostril breathing ( <i>Nadi Shodhana Pranayama</i> ), meditation	corpse pose, alternate nostril breathing, meditation	corpse pose; alternate nostril breath; alternate nostril breath with retention ( <i>Anulom Vilom</i> ); loving-kindness meditation; gratitude meditation; meditation on breath
<b>Study 2</b>	<b>Weeks 1–3</b>	<b>Weeks 4–6</b>	<b>Weeks 7–10</b>
Centering and warm-up	Meditation on breath; three-part and victorious breath; ten churnings; standing sun breaths; breath of joy; standing meditation	Meditation on breath; three-part, victorious, and skull-shining breath; ten churnings; standing sun breaths; breath of joy; standing meditation	Meditation on breath; three-part, victorious, and skull-polishing breaths; ten churnings; standing meditation; pulses on breath between extended mountain and awkward pose with twists
Standing postures; Seated, prone and supine postures; Cool-down and centering	2x half sun salutations; 3x modified classical sun salutations (extended mountain, standing forward bend, extended forward bend, standing forward bend, knee-down lunge, knee-down plank, child's pose, table, downward facing dog, table, knee-down lunge, standing forward bend, extended forward fold, standing forward fold, awkward pose, extended mountain); tree; mountain; rag doll; table	2x half sun salutations; 1x modified classical sun salutation; 1x modified sun salutation B (extended mountain, standing forward bend, extended forward fold, standing forward fold, honorable pose ( <i>Anjaneyasana</i> ), knee-down plank, cobra, knee-down plank, child's, table, downward facing dog, table, honorable pose, standing forward fold, awkward pose, extended mountain); warrior 1; goddess pulsing in and out with the breath; mountain; standing forward fold; knee-down plank	2x half sun salutations; 1x classical sun salutation; 1x sun salutation B with pulsing twists on the breath in warrior 1; 1x sun salutation B; 1x sun salutation B with warrior 2, lateral angle and reversed warrior; extended mountain; modified warrior III; extended mountain; standing forward fold; extended forward fold; standing forward fold; rag doll; table
	Sphinx; half locust; cobra; table; child's; seated spinal twist; knee-down seated spinal twist; supine half wind-relieving pose; knees to chest pose; blissful baby	Half locust; boat; child's; seated spinal twist; head to knee forward fold; supine half wind-relieving pose; knees to chest pose; blissful baby	Half locust; boat; bow; child's; table; pigeon; bridge; happy baby; knee-down twist
	Corpse pose; alternate-nostril breath; meditation on breath.	Corpse pose; alternate-nostril breath; meditation on breath	Corpse pose; alternate nostril breath; alternate nostril breath with retention; loving-kindness meditation; gratitude meditation; meditation on breath.

Table 2. *continued.*

Study	Session	Week									
		1	2	3	4	5	6	7	8	9	10
1	Workshop										
	Yoga										
2	Workshop										
	Yoga										

**Table 3. Frequency of workshop and yoga sessions for Study 1 (YWL-YE) and Study 2 (YWL-YN). Squares indicate once per week.**

element), which may facilitate obesity through several pathways, including a stress response to excess activity that may cause the nervous system to crave and mobilize more kapha, thereby increasing fat storage. A third aim was increase of digestive fire or agni. Among other implications, Ayurveda posits weak agni to engender poor digestion of food resulting in excess fat storage, while strong digestive fire increases metabolism and burns fat stores (Lad, 2002).

**Yoga sessions.** Each yoga session comprised a 90-minute Kripalu Yoga class (Table 2) and a 30-minute sharing circle. The yoga portion included breathing exercises, postures, final relaxation, and meditation. Consistent with Ayurveda-inspired principles, yogic practices were moderately intense and designed to reduce excess kapha while soothing vata and increasing agni. Participants were given the option to remain in silence during the sharing circle if desired.

**Home practice.** In both studies, required weekly home practice was facilitated by audio recordings and paper handouts of breathing and posture instruction that depicted the practices. Adherence to home practice data were not collected. Study 1 participants were asked to engage in one of the following home practices for 30 minutes each week: (1) brisk outdoor walk; (2) deep breathing; (3) meditation; or (4) yoga postures. Study 2 home practice guidelines were expanded and revised based on Study 1 feedback. Each week, participants were asked to engage in two 30-minute sessions of gentle yoga and one of the following 15-minute sessions: (1) brisk outdoor walk; (2) breathing exercises; or (3) meditation. In addition to this formal home practice, participants were invited to reflect on the teachings for each week, to integrate these into their lives as best they were able, and to attend the following week's class prepared to discuss.

### Feasibility

Feasibility was determined by examining recruitment, attendance, attrition, and adverse events. Attendance was collected at each session. Those who elected to drop out of the study were asked to provide a reason for their discontinuation.

### Practitioner-Pilot Evaluation of Study One

In Study 1, a one-hour focus group was used to gather data from participants following the intervention. Participants discussed perceptions of change and intervention acceptability in view of the next study enrolling yoga-naïve participants. The focus group data were reviewed for representative themes of program usability and improvement.

### Measures

Self-reported weight, height, and demographics were collected at all time points, in addition to self-report questionnaires about mindful eating, self-compassion, body image dysphoria, weight loss self-efficacy, and body awareness.

*Self-reported clinically significant weight loss* is defined as greater than 5% of total body weight lost (%TBWL), with %TBWL calculated as the percentage of baseline weight self-reported lost at each time point (Blackburn, 1995). Self-reported mean BMI reduction and body weight loss were also reported.

*The Mindful Eating Questionnaire (MEQ)* is a 28-item self-report measure assessing mindful eating. Items are rated on a Likert scale from 1 (never/rarely) to 4 (usually/always), with greater scores indicating more mindful eating. The MEQ includes five factors that load on a single higher-order factor: disinhibition, awareness, external cues, emotional response, and distraction. Available data suggest adequate reliability and construct validity (Framson et al., 2009).

<p><b>Eating and dietary guidelines</b></p> <p>Fresh, seasonal whole-foods diet; increase plant-based foods</p> <p>Avoidance of kapha-increasing foods (e.g., dairy, meats, sugar, oils)</p> <p>Moderate dietary intake (fist-size)</p> <p>Eating meals while seated</p> <p>Three meals per day at regular intervals (no snacks or skipping meals)</p> <p>Largest meal consumed 11:30 AM - 2:00 PM</p> <p>Dinner consumed 5:00 PM - 7:00 PM</p> <p>Allow two hours after eating before nighttime sleep or napping</p> <p>Drink warm or hot water</p> <p>Refrain from water consumption after meals</p> <p>Mindful eating</p>
<p><b>Exercise routines</b></p> <p>Regular yoga, moderate walking, or other preferred movement</p>
<p><b>Cleansing routines</b></p> <p>Daily light oil massage (<i>abhyanga</i>)</p> <p>Dry skin brushing (<i>garshana</i>)</p> <p>Nasal rinsing (<i>jala neti</i>) and oil/herb lubrication (<i>nasya</i>)</p> <p>Tongue scraping</p>
<p><b>Ecological modification</b></p> <p>Reduce media consumption</p> <p>Remove TV from kitchen and bedroom</p> <p>Improve home food environment (e.g., discard packaged/poor quality foods and replace with fresh/whole foods)</p> <p>Create aesthetically pleasing dining environment</p>
<p><b>Balance circadian rhythms</b></p> <p>Avoidance of activating or arousing activities before bed (e.g., eating, Internet)</p> <p>Self-foot massage with warm sesame oil</p> <p>Bedtime 10:00 PM - 11:00 PM</p> <p>Awaken before sunrise</p>

**Table 4. Ayurvedic lifestyle guidelines (*dinacharya*).**

*The Weight Efficacy Lifestyle Questionnaire (WELQ)* is a 20-item scale designed to measure weight loss self-efficacy. Items are rated on a Likert scale from 1 (not confident) to 9 (very confident). The WELQ generates five situational factors that load on a global scale: negative emotions, availability, social pressure, physical discomfort, and positive activities. The WELQ has demonstrated adequate validity and sensitivity (Clark, Abrams, Niaura, Eaton, & Rossi, 1991; Rapoport, Clark, & Wardle, 2000).

*The Self-Compassion Scale (SCS)* is a 26-item self-report measure focused on one's ability to be forgiving and kind to oneself in difficult circumstances. The SCS employs a Likert scale ranging from 1 (almost never) to 5 (almost always) and includes six components (self-kindness, self-judgment, common humanity, isolation, mindfulness, and over-identification) that load on a single higher-order factor, from which a total score of general self-compassion can be derived. The SCS has demonstrated good reliability and validity (Neff, 2003).

*The Body Awareness Questionnaire (BAQ)* is an 18-item scale that measures attentiveness to normal, non-emotive body awareness processes. The BAQ is a Likert scale from 1 (not at all true of me) to 7 (very true of me), and has demonstrated adequate reliability and validity (Shields, Mallory, & Simon, 1989).

*The Situational Inventory of Body Image Dysphoria—Short Form (SIBID-S)* was used to assess negative body image emotions. Participants rated the frequency of body image dysphoria in 20 situational contexts from 0 (never) to 4 (almost or almost always), yielding a total score. The SIBID-S is widely used with good reliability and validity (Cash, 2002).

## Data Analysis

Baseline demographics, percentage of self-reported total weight lost (%TBWL), and changes in weight and BMI were assessed using descriptive statistics. For our analysis of process variables in each study, paired student's t-tests compared changes in mean values from baseline to post-treatment (10 weeks) and from baseline to three-month follow-up (three months after intervention completion). Cohen's *d* was calculated with a formula that adjusts for the association between paired variables (Morris & DeShon, 2002). To correct for multiple comparisons in our primary analysis, the Bonferroni adjustment defined statistical significance as  $p < 0.006$ .

Independent t-tests were conducted to assess differences between survey completers and non-completers at post-treatment and follow-up, as well as intervention completers and non-completers. Post-treatment and follow-up survey completers were defined as those who submitted

post-treatment or follow-up surveys, irrespective of whether they completed the intervention. Due to the exploratory nature of these secondary analyses, statistical significance was defined as  $p \leq 0.05$ .

## Results

### Study One

**Sample.** Participants ( $n = 22$ ) had a mean age of  $48.2 \pm 14.3$  years, mean BMI  $30.8 \pm 4.2$  kg/m<sup>2</sup> and mean yoga experience of  $2.2 \pm 1.4$  years; six were yoga instructors (27.2%). Participants were Caucasian (100%) with generally high levels of education (84.2% had a four-year college degree or professional training beyond college). Total household income before taxes was reported as follows: \$34,999 or less (47.4%); \$35,000-65,000 (31.6%); \$70,000 or more (10.5%). Income data was not provided by 10.5% of respondents.

**Feasibility.** Twenty-two participants enrolled in the study (51.2% participation rate, and 64.7% enrollment rate). With respect to study attrition, 18.2% ( $n = 4$ ) of participants did not complete the intervention, 9.1% ( $n = 2$ ) did not complete post-treatment surveys, and 40.9% ( $n = 9$ ) did not complete follow-up assessments (Figure 1). The mean number of sessions attended was  $9.6 \pm 3.15$  (69%) out of 14, with a range of 4 to 14. Post-treatment survey completers ( $n = 20$ , 95.2%) did not differ from post-treatment non-completers on baseline measures. Relative to follow-up non-completers, follow-up completers ( $n = 13$ , 59.1%) demonstrated significantly greater baseline to post-treatment reductions in self-reported BMI ( $p = .050$ ) and increases in mindful eating ( $p = .031$ ) and weight loss self-efficacy ( $p = .042$ ). No statistically significant differences were observed on baseline measures or on baseline to post-treatment change between intervention completers and non-completers. No adverse events were reported.

**Practitioner-Pilot Evaluation.** Fifty-five percent of post-treatment completers ( $n = 11$ ), all of whom completed the intervention, elected to participate in the focus group. Focus group participants had significantly greater baseline BMI than did non-participants ( $p = .017$ ), but were otherwise indistinguishable from non-participants on baseline measures or in changes over time.

Overall, participants reported benefiting from the intervention, suggesting good acceptability. These yoga-experienced participants expressed enthusiasm for the Ayurvedic content. Study participants cited multiple factors as supporting their weight loss efforts, including the share circles (*"I loved the opportunity to hear other people's challenges and successes, it made me feel less alone"*); mindful eating (*"the mindful eating without judgment was huge... it*

*made an enormous impact on me and changed my entire eating experience"*) and mindfulness practices (*"being present... made it pretty well impossible to overeat or eat something I didn't want or wasn't hungry for"*); and breathing techniques (*"It's almost like the breath fills me up so I'm not as hungry"*).

A number of suggestions were offered by participants to modify the next intervention for yoga novices. These included (1) a posture clinic to teach basic safety and alignment, (2) gradual introduction of postures, (3) additional instructor assistance for students in physical postures, (4) modifications for larger bodies, (5) gentler yoga postures, (6) simplification of Ayurveda-inspired content, and (7) repetition of Kripalu Yoga philosophy. These suggestions were integrated into the expanded content for Study 2.

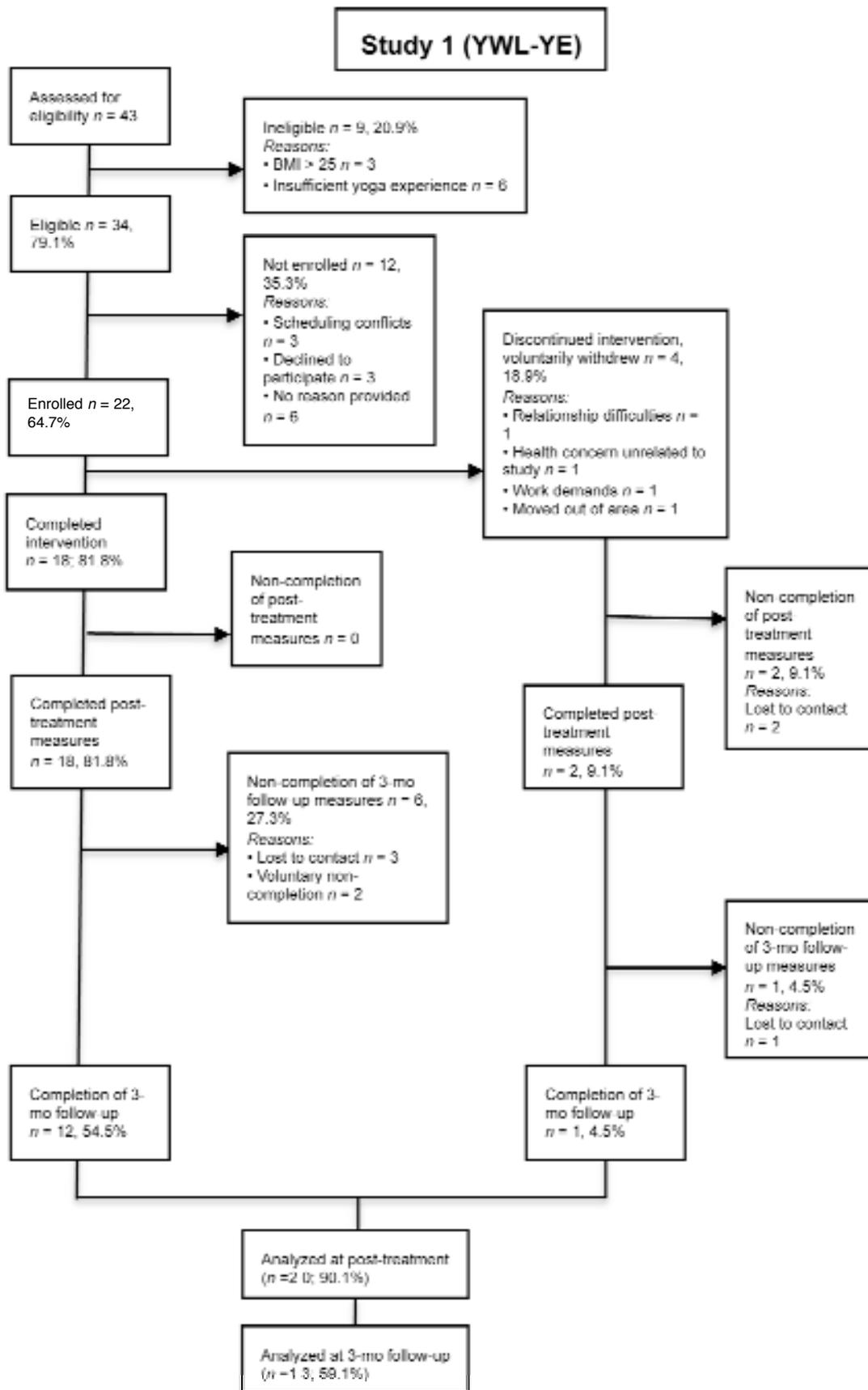
**Process Variables.** All self-reported process variables targeted by the intervention changed in the hypothesized directions from baseline to post-treatment (Table 5), with most changes being medium to large in effect size and statistically significant. A similar pattern was observed at follow-up (Table 6). Most variables further improved from post-treatment gains, except body image dysphoria (mean difference  $-0.5 \pm 0.79$ ,  $p = 0.06$ , Cohen's  $d = 0.7$ ).

**Self-Reported Weight Loss.** Mean percentage of self-reported total body weight lost (%TBWL) among those reporting at post-treatment (10 weeks,  $n = 20$ ) was  $4 \pm 3\%$  (mean  $7.6 \pm 5.8$  pounds lost, mean BMI reduction of  $1.25 \pm .95$  kg/m<sup>2</sup>). At follow-up (three months following intervention completion) among those reporting ( $n = 13$ ), %TBWL was clinically significant (i.e., >5%) at  $6.8 \pm 4.2\%$  (mean  $13 \pm 9$  pounds lost, mean BMI reduction of  $2.1 \pm 1.4$  kg/m<sup>2</sup>).

### Study Two

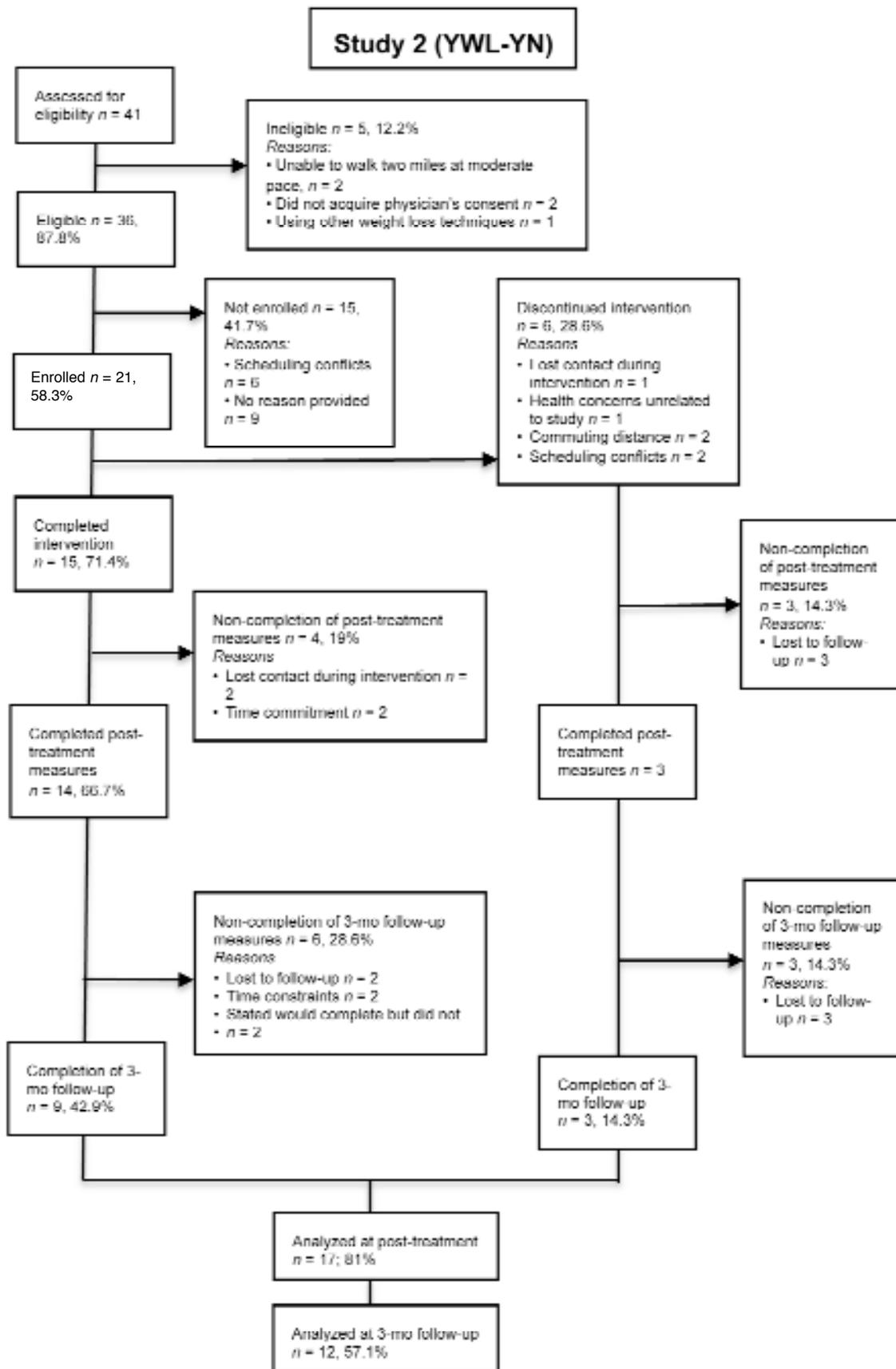
**Sample.** Study participants ( $n = 21$ ) had a mean age of  $49.4 \pm 10.7$  with mean BMI  $35.5 \pm 6.8$  kg/m<sup>2</sup>. Most were Caucasian (95.2%) and possessed a four-year college degree or professional training beyond college (71.4%). Total household income before taxes was \$34,999 or less (28.6%); \$35,000-65,000 (19%); \$70,000 or more (19%); 33.4% of respondents did not provide income data.

**Feasibility.** Twenty-one participants enrolled in the study (51.2% participation rate, 51.2% enrollment rate). Regarding study attrition, 28.6% ( $n = 6$ ) discontinued the intervention, 19% ( $n = 4$ ) did not complete post-treatment surveys, and 42.3% ( $n = 9$ ) did not complete follow-up assessments (Figure 2). Participants attended approximately  $13.8 \pm 5.21$  sessions out of 20 (69%), with a total range of 9 to 20. No differences on baseline measures or baseline to post-treatment change were observed between post-treatment survey completers ( $n = 17$ , 81%) and non-completers. Relative to follow-up non-completers, follow-up completers



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Figure 1. Consort diagram.



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Figure 2. Consort diagram.

Construct	Study 1, YWL-YN ( <i>n</i> = 20)				
	T1 Mean (SD)	T2 Mean (SD)	T2-T1 $\Delta$	<i>P</i>	<i>d</i>
Mindful eating (MEQ)	2.6 (0.3)	3.0 (0.3)	0.4	.001	-1.0
MEQ-Awareness	2.5 (0.6)	2.8 (0.6)	-0.4	.004	-0.8
MEQ-Distracton	2.5 (0.7)	2.7 (0.5)	-0.4	.02	-0.6
MEQ-Disinhibition	2.7 (0.6)	3.0 (0.5)	-0.5	.001	-1.1
MEQ-Emotional	2.4 (0.6)	3.0 (0.6)	-0.6	.005	-0.8
MEQ-External	2.7 (0.4)	2.8 (0.5)	-0.2	.16	-0.4
Self-compassion	3.2 (0.8)	3.4 (0.9)	0.2	.08	-0.5
Body image dysphoria	1.8 (0.8)	1.5 (0.6)	-0.3	.001	1.0
Weight self-efficacy	13.0 (5.0)	18.5 (5.3)	5.1	.001	-1.1
Body awareness	4.0 (1.0)	4.6 (0.7)	0.6	.002	-0.8
<b>Study 2, YWL-YE (<i>n</i> = 17)</b>					
Mindful eating (MEQ)	2.6 (0.4)	2.9 (0.4)	-0.3	.001	-1.5
MEQ-Awareness	2.6 (0.5)	3.0 (0.5)	-0.3	.001	-1.1
MEQ-Distracton	2.5 (0.5)	2.9 (0.4)	-0.2	.10	-0.5
MEQ-Disinhibition	2.6 (0.5)	3.1 (0.5)	-0.3	.004	-0.9
MEQ-Emotional	2.5 (0.5)	3.1 (0.6)	-0.6	.001	-1.7
MEQ-External	2.6 (0.3)	2.8 (0.5)	-0.03	.80	-0.2
Self-compassion	3.0 (0.8)	3.4 (0.5)	0.4	.004	-1.2
Body image dysphoria	2.6 (0.8)	2.2 (0.9)	-0.4	.02	1.4
Weight self-efficacy	12.9 (5.7)	14.6 (8.6)	1.7	.23	-0.3
Body awareness	4.1 (0.7)	4.5 (0.9)	0.4	.04	-0.6

**Table 5. Process variables: Change between baseline and post-treatment (paired t-test), by study.**

(*n* = 12, 57.1%) demonstrated significantly greater baseline to end improvements in body image dysphoria ( $p = 0.008$ ) and mindful eating ( $p = 0.026$ ). Intervention completers demonstrated significantly higher baseline mindful eating ( $p = 0.017$ ) and weight loss self-efficacy ( $p = 0.021$ ) than did non-completers. No adverse events were reported.

**Process Variables.** All self-reported process variables targeted by the intervention changed in the hypothesized directions from baseline to post-treatment (Table 5), with most changes being medium to large in effect size and statistically significant. A similar pattern was observed at follow-up (Table 6). Most variables further improved from post-treatment gains, excepting MEQ emotional eating (mean difference  $-0.4 \pm 0.51$ ,  $p = 0.02$ , Cohen's  $d = -0.8$ ).

**Self-Reported Weight Loss.** Mean percentage of self-reported %TBWL at post-treatment (10 weeks, *n* = 16) was  $1.7 \pm 2.0\%$  (mean  $3.3 \pm 3.7$  pounds lost, mean BMI reduction of  $0.6 \pm 0.6$  kg/m<sup>2</sup>). At follow-up (3 months following intervention completion, *n* = 12), %TBWL was  $4.3 \pm 3.0\%$  (mean  $8.5 \pm 6.6$  pounds lost, mean BMI reduction  $1.4 \pm 1.1$  kg/m<sup>2</sup>). Neither parameter reached clinical significance (i.e., >5.0%).

## General Discussion

These are the first published studies to examine the feasibility and preliminary effectiveness of a group-based, yoga and Ayurveda-inspired approach to the promotion of psychosocial health and attenuation of overweight/obesity in both yoga-experienced and yoga-naïve individuals. These outcomes suggest that this approach is feasible in both groups. Overall, both studies demonstrated that a yoga-based program with Ayurveda-inspired components can be effectively tailored for participants with different levels of yoga experience.

Feasibility was consistent in both studies, both featuring similar participation and enrollment rates. Despite the additional six classes in the second program, participants evidenced the same rate of attendance in both studies (69%). The lack of adverse events suggests that both interventions were fairly safe. Lower intervention attrition rates were observed among YWL-YE participants (18.2%) compared to YWL-YN participants (28.6%), the latter consistent with rates in other clinical trials of weight-loss seeking community samples (e.g., 25% for a 12-week Weight

<b>Study 1, YWL-YN (<i>n</i> = 13)</b>					
<b>Construct</b>	<b>T1 Mean (SD)</b>	<b>T3 Mean (SD)</b>	<b>T3-T1<math>\Delta</math></b>	<b><i>P</i></b>	<b><i>d</i></b>
Mindful Eating (MEQ)	2.5 (0.3)	3.1 (0.3)	0.6	.001	-1.8
MEQ-Awareness	2.6 (0.5)	3.1 (0.5)	0.6	.001	-1.2
MEQ-Distraction	2.5 (0.6)	3.0 (0.4)	0.5	.003	-1.0
MEQ-Disinhibition	2.6 (0.5)	3.3 (0.5)	0.7	.001	-1.8
MEQ-Emotional	2.5 (0.6)	3.2 (0.3)	0.7	.001	-1.1
MEQ-External	2.5 (0.2)	3.0 (0.6)	0.4	.05	-0.7
Self-compassion	3.3 (0.9)	3.8 (0.9)	0.5	.003	-1.1
Body image dysphoria	1.7 (0.7)	1.2 (0.4)	-0.5	.03	0.7
Weight self-efficacy	11.7 (4.1)	19.9 (5.4)	8.2	.001	-1.6
Body awareness	3.9 (1.1)	4.6 (0.9)	0.7	.001	-1.4
<b>Study 2, YWL-YE (<i>n</i> = 12)</b>					
Mindful Eating (MEQ)	2.6 (0.3)	3.0 (0.3)	0.4	.001	1.4
MEQ-Awareness	2.6 (0.6)	3.0 (0.4)	0.4	.001	-1.5
MEQ-Distraction	2.6 (0.6)	2.9 (0.3)	0.3	.04	-0.7
MEQ-Disinhibition	2.7 (0.6)	3.2 (0.3)	0.3	.001	-1.4
MEQ-Emotional	2.5 (0.5)	3.0 (0.5)	0.4	.02	-0.8
MEQ-External	2.6 (0.3)	3.0 (0.6)	0.4	.03	-0.8
Self-compassion	2.7 (0.8)	3.5 (1.0)	0.8	.001	-1.0
Body image dysphoria	2.5 (1.0)	1.7 (1.1)	-0.8	.001	1.4
Weight self-efficacy	13.1 (4.1)	24.2 (8.5)	11.1	.001	-0.5
Body awareness	4.1 (0.7)	4.9 (1.0)	0.8	.02	-0.9

**Table 6. Process variables: Change between baseline and follow-up (paired t-test), by study.**

Watchers trial or 65% for usual care; Rippe et al., 1998).

Many characteristics unmeasured here may explicate differential attrition. For example, some evidence indicates greater self-regulation and improved mental and physical health among yoga practitioners relative to novices (Park, Braun, & Siegel, 2015; Gard, Noggle, Park, Vago, & Wilson, 2014), suggesting that YWL-YE participants may be more likely to sustain participation in such curricula, particularly given their baseline preference for and knowledge of yoga. Other unmeasured factors, such as medical or psychological comorbidities associated with a greater BMI in the YWL-YN group, may have also played a role.

The higher dropout rate in the YWL-YN group may also suggest lower acceptability in this group. YWL-YN, while carefully tailored from feedback by yoga-experienced participants to suit yoga naïves, may have included too much novel material. It is possible that an introduction to yoga, mindfulness, or Ayurveda alone may have proven more helpful, rather than interweaving these components simultaneously. Future work may consider examining a modular or tiered approach. For example, an introduction to yoga and mindfulness may be offered at first and then

later, once the mind-body connection has been better established, the intervention could integrate Ayurveda-inspired lifestyle principles, which may then be more intuitively grasped and readily implemented.

Critically, other research published since this study was conducted suggested that a whole-system Ayurvedic medical approach for obesity was well accepted among US-dwelling, yoga-naïve individuals (Rioux et al., 2014). Thus, while our effort to deliver group-based “universal” Ayurveda-inspired principles was hypothesized to enhance appeal with yoga naïves and to bear potential for enhanced disseminability relative to the comparatively greater resources required by an individualized approach, greater attrition in the YWL-YN group may feasibly reflect the sacrifice in efficacy and acceptability of such an approach relative to the more individualized, focused approach that is a hallmark of Ayurvedic medicine. These hypotheses represent an important focus for future study.

While the two studies differed somewhat in program content and sample, consistent outcomes on process variables (e.g., mindful eating, body image dysphoria, weight loss self-efficacy) suggest that the core teachings were effec-

tively translated. Self-reported reductions in %TBWL were present for both groups, with only the YWL-YE group self-reporting clinically significant %TBWL (i.e., >5%) at follow-up. Overall, self-reported weight losses were lower for the YWL-YN group than the YWL-YE group, despite YWL-YN beginning the study with higher BMI and receiving 30% more contact hours. Given that YWL-YN participants completed the program shortly before Thanksgiving, and follow-up assessments were collected after the holidays, a period commonly associated with weight regain, these findings generate speculation that the intervention effectively supported weight maintenance. However, the self-report nature of these data and lack of control group are limiting factors, underscoring the need for future investigation to better elucidate the impact of YWL-YN on weight loss and maintenance of percentage weight lost.

### Strengths and Limitations

A major strength of these studies was their inclusion of Ayurveda-inspired principles in a yoga-based group context, as well as the novel pilot-practitioner design. Because yoga is commonly practiced in the United States, we hypothesized that coupling Ayurveda-inspired content with yoga in a group-based, manualized context would enhance feasibility and effectiveness of such content among overweight/obese women in this population. Future studies might profitably compare the feasibility and effectiveness of this group-based YWL approach to Ayurvedic medical treatment or group-based Ayurvedic curricula supplemented with personalized consultations.

Other strengths include the focus on process outcomes and the use of validated psychosocial measures. While such outcomes are preliminary, they generate hypotheses for future study. For example, increases in weight loss self-efficacy and self-compassion have been linked to reductions in body weight (e.g., Mantzios & Wilson, 2013; Shin et al., 2011) and may mediate weight loss in future trials.

While YWL represents a novel approach to fostering psychosocial health and self-reported weight loss, conclusiveness of quantitative outcomes is limited. No control group or randomization procedures were employed. Thus, positive outcomes may be attributable to nonspecific effects (e.g., attention) rather than the content of the intervention, and seasonal effects may have blunted our ability to capture change in the YWL-YN sample. These studies also lacked rigorous inclusion and exclusion criteria, and they did not collect data on obesity-related comorbidities or medication intake, which may have confounded treatment outcomes. However, the focus of these trials was to determine feasibility and preliminary effectiveness in community samples, with a focus on external rather than internal validity. Nonetheless, future research should investigate the efficacy

of YWL through well-controlled trials that address these limitations.

We did not collect data on adherence to intervention guidelines and maintenance following completion, which is a limitation given the renowned challenges of maintaining behaviors following obesity treatment (Brownell, 2010). Future research should thus explore protocol adherence and longitudinal rates of behavior maintenance relating to yoga and Ayurveda, which may differ from standard of care treatments. However, high attrition rates suggest that maintenance may represent a similar challenge in this type of treatment.

Importantly, as previously noted, the present study did not assess characteristics that may have differentially predicted treatment success or intervention attrition, such as comorbid medical or psychological conditions, eating or exercise behaviors, medications, or Ayurvedic constitution. Lack of measurement of potentially moderating characteristics is a serious limitation that requires rectification in future research.

Our ability to detect change is also limited by our small sample size, increasing the potential rate of Type II error. However, while larger sample sizes should increase the power to detect effects, most outcomes reached statistical significance and evidenced medium to large effect sizes. As noted previously, there are significant limitations to self-reported weight loss, and findings described here may thus be viewed as hypothesis-generating only, given our inability to ascertain whether these reports reflect actual changes in weight.

Selection bias is also a significant limitation. Excepting a comparatively broad range of socioeconomic statuses, participants were self-selected, female, and demographically homogenous (Caucasian, high levels of education), largely reflecting the sociodemographics common to US yoga practitioners (Birdee et al., 2008) and CAM users (Barnes, Bloom, & Nahin, 2008). This demographic homogeneity underscores the need for future work with more targeted efforts to recruit samples more representative of the US population, including Persons of Color, those of diverse socioeconomic origins, and men (Park et al., 2015). Relatedly, those self-selecting to participate in a yoga intervention may systematically differ from those who do not (e.g., in motivation; affinity toward yoga or CAM; intentions and readiness to change). Future research should blind recruitment materials to better assess this protocol's acceptability in the broader weight-loss seeking population, to improve generalizability of findings.

Participants in qualitative data collection in both studies characteristically differed on key indices from non-participants. Higher baseline BMI among yoga practitioners (YWL-YE) volunteering for focus group participation may

suggest the program was more acceptable for this group. An additional limitation is that these studies did not track frequency and duration of home practice, although this was a critical intervention element. Future studies would benefit from standardized measurement of adherence to home practice and relations between home practice adherence and outcomes.

Development of these curricula was sponsored by an established yoga center, raising concerns regarding conflict of interest. However, the YWL curricula were developed for the sole purpose of scientific study and are not considered “branded” programs. Further, the center in question had no intent of marketing or offering the program for any purpose (e.g., fees, guest programming) beyond the present line of research. Program sessions were also offered on-site at the retreat center, presenting the possibility of non-specific effects attributable to the retreat environment and limited generalizability. These effects were deliberately minimized by offering classes in a neutral building apart from the main retreat center to optimize generalizability to non-retreat settings.

High attrition for follow-up survey completers was problematic in both studies, likely in part reflecting the lack of participant incentives, a standard practice in clinical trials. It may also be due to other possibilities, such as decreased benefit in the months following intervention cessation. Notably, high attrition rates limit our ability to ascertain whether non-reporters failed to achieve sustained benefits. Results should thus be considered with caution. Results suggested that follow-up survey completers experienced greater baseline to post-treatment improvements relative to intervention completers, suggesting response bias. Future investigation is necessary to lessen attrition and determine characteristics associated with successful implementation and maintenance.

Ayurvedic medicine is a whole-system approach that targets the individual with personalized recommendations and treatment and should always start with an individual consultation with a trained Ayurvedic practitioner (Lad, 2002). The curricula employed here utilized selected principles inspired by general Ayurvedic theory and must thus be conceptualized as Ayurveda-inspired, in contrast to Ayurvedic medical treatment. We intentionally forewent the traditional emphasis on personalization to distill general lifestyle principles hypothesized to foster weight management and wellbeing in a group context. This approach represents the first step toward our longer-term interest in investigating whether such curricula may prove a readily disseminable adjunct to weight loss treatment or maintenance in mainstream healthcare and community settings. While these curricula may thus prove limited by their departure from Ayurvedic medicine, representing instead a

modernized adaptation of select Ayurvedic principles in combination with Kripalu Yoga and other factors (e.g., mindfulness, self-compassion, media literacy), the included factors were selected by trained Ayurvedic lifestyle practitioners who viewed them as theoretically concordant with Ayurveda. Further, all knowledge, including Ayurvedic knowledge, continues to evolve and incorporate culturally relevant and compatible approaches where appropriate (Conboy et al., 2009; Smith & Wujastyk, 2008)

## Conclusions

Given these limitations, our findings can at best be classified as hypothesis-generating. Future research should investigate the differential contributions of Ayurveda-inspired principles and related constituents, including yoga, to improvements in psychosocial health and objective metrics of weight loss and maintenance in different populations. Relatedly, improvements in psychosocial variables observed here, such as mindful eating and body image dysphoria, may synergistically mediate improvements in weight or health behaviors, warranting future investigation.

In conclusion, applying a group yoga-based intervention with Ayurveda-inspired components to weight management is a novel approach that holds promise for addressing psychosocial etiologies of obesity. These studies demonstrate the preliminary feasibility of this approach in both yoga-experienced and yoga-naïve samples. Most pertinently, these studies highlight YWL's potential to facilitate improvement in psychological factors related to weight loss and maintenance. Pending further investigation, this approach may prove useful in promoting healthy lifestyles and, given the relatively low costs, be broadly disseminable.

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## References

- Askegaard, S., & Eckhardt, G. M. (2012). Glocal yoga: Re-appropriation in the Indian consumptionscape. *Marketing Theory*, 12(1), 45–60. doi:10.1177/1470593111424180
- Barnes, P. M., Bloom, B., & Nahin, R. L. (2008). Complementary and alternative medicine use among adults and children: United States, 2007. *National Health Statistics Reports*, (12), 1–23.

- Birdee, G. S., Legedza, A. T., Saper, R. B., Bertisch, S. M., Eisenberg, D. M., & Phillips, R. S. (2008). Characteristics of yoga users: Results of a national survey. *Journal of General Internal Medicine, 23*(10), 1653-8. doi:10.1007/s11606-008-0735-5
- Blackburn, G. (1995). Effect of degree of weight loss on health benefits. *Obesity Research, 3 Suppl 2*(14), 211s-216s. doi:10.1002/j.1550-8528.1995.tb00466.x
- Braun, T. D., Park, C. L., & Conboy, L. A. (2012). Psychological well-being, health behaviors, and weight loss among participants in a residential, Kripalu yoga-based weight loss program. *International Journal of Yoga Therapy, 22*, 9-21.
- Brownell, K. D. (2010). The humbling experience of treating obesity: Should we persist or desist? *Behaviour Research and Therapy, 48*(8), 717-719. doi:10.1016/j.brat.2010.05.018
- Cash, T. (2002). The Situational Inventory of Body-Image Dysphoria: Evidence and development of a short form. *International Journal of Eating Disorders, 32*, 362-366. doi: 10.1002/eat.10100
- Clark, M. M., Abrams, D. B., Niaura, R. S., Eaton, C. A., & Rossi, J. S. (1991). Self-efficacy in weight management. *Journal of Consulting and Clinical Psychology, 59*(5), 739-744. doi:10.1037/0022-006X.59.5.739
- Clarke, T. C., Black, L. I., Stussman, B. K., Barnes, P. M., & Nahin, R. L. (2015). Trends in the use of complementary health approaches among adults: United States, 2002-2012. *National Health Statistics Reports, 79*(1), 1-15.
- Conboy, L., Edshteyn, I., & Garivaltis, H. (2009). Ayurveda and Panchakarma: Measuring the effects of a holistic health intervention. *The Scientific World Journal, 9*, 272-280. doi:10.1100/tsw.2009.35
- Conboy, L., Wilson, A., & Braun, T. (2010). Moving beyond health to flourishing: The effects of yoga teacher training. *The Scientific World Journal, 10*, 788-795. doi:10.1100/tsw.2010.87
- Daubenmier, J. J. (2005). The relationship of yoga, body awareness, and body responsiveness to self-objectification and disordered eating. *Psychology of Women Quarterly, 29*, 207-219. doi:10.1111/j.1471-6402.2005.00183.x
- Desikachar, T. K. V. (1999). *The heart of yoga: Developing a personal practice*. Rochester, VT: Inner Traditions International.
- Dunn, K. D. (2010). *The effectiveness of Hatha yoga on symptoms of anxiety and related vulnerabilities, mindfulness, and psychological wellbeing in female health care employees*. (Doctoral dissertation). Retrieved from Dissertation Abstracts International, 70(7-A), 2403.
- Faulds, R. (2005). *Kripalu Yoga: A guide to practice on and off the mat*. New York, NY: Bantam Dell.
- Framson, C., Kristal, A. R., Schenk, J. M., Littman, A. J., Zeliadt, S., & Benitez, D. (2009). Development and validation of the Mindful Eating Questionnaire. *Journal of the American Dietetic Association, 109*(8), 1439-44. doi:10.1016/j.jada.2009.05.006
- Frawley, D. (2000). *Ayurvedic healing: A comprehensive guide*. Wisconsin: Lotus Press.
- Gard, T., Brach, N., Hölzel, B. K., Noggle, J. J., Conboy, L. A., & Lazar, S. W. (2012). Effects of a yoga-based intervention for young adults on quality of life and perceived stress: The potential mediating roles of mindfulness and self-compassion. *The Journal of Positive Psychology, 7*(3), 165-175. doi:10.1080/17439760.2012.667144
- Gard, T., Noggle, J. J., Park, C. L., Vago, D. R., & Wilson, A. (2014). Potential self-regulatory mechanisms of yoga for psychological health. *Frontiers in Human Neuroscience, 8*, 770. doi:10.3389/fnhum.2014.00770
- Hammerschlag, R. (1998). Methodological and ethical issues in clinical trials of acupuncture. *Journal of Alternative and Complementary Medicine, 4*(2), 159-171. doi:10.1089/acm.1998.4.159
- Jones, L. R., Wilson, C. I., & Wadden, T. A. (2007). Lifestyle modification in the treatment of obesity: An educational challenge and opportunity. *Clinical Pharmacology and Therapeutics, 81*(5), 776-779. doi:10.1038/sj.clpt.6100155
- Joshi (Deoloe), S., Deole S, Y., Viyas, G. H., & Dash, S. C. (2009). Management of overweight and obesity through specific yogic procedures. *AYU An International Quarterly Journal in Ayurveda, 30*(4), 425-435.
- Kristal, A. R., Littman, A. J., Benitez, D., & White, E. (2002). Yoga practice is associated with attenuated weight gain in healthy, middle-aged men and women. *Alternative Therapies in Health and Medicine, 11*(4), 28-33.
- Lad, V. (2002). *Textbook of Ayurveda: Fundamental principles of Ayurveda, Volume I*. New Mexico: The Ayurvedic Press.
- Lois, K., Kumar, S., Williams, N., & Birrell, L. (2011). Can self-reported height and weight be relied upon? *Occupational Medicine, 61*(8), 590-592. doi:10.1093/occmed/kqr140
- Mantzios, M., & Wilson, J. C. (2013). Making concrete construals mindful: A novel approach for developing mindfulness and self-compassion to assist weight loss. *Psychology & Health, 28*(12), 1-21. doi:10.1080/08870446.2013.863883
- Moliver, N., Chartrand, M., Haussmann, R., Mika, E., Burrus, S., & Khalsa, S. (2011). Increased Hatha yoga experience predicts lower body mass index and reduced medication use in women over 45 years. *International Journal of Yoga, 4*(2), 77. doi:10.4103/0973-6131.85490
- Morris, S. B., & DeShon, R. P. (2002). Combining effect size estimates in meta-analysis with repeated measures and independent-groups designs. *Psychological Methods, 7*(1), 105-125. doi:10.1037/1082-989X.7.1.105
- Neff, K. D. (2003). The development and validation of a scale to measure self-compassion. *Self and Identity, 2*, 223-250. doi:10.1080/15298860390209035
- Parham, E. S. (1993). Enhancing social support in weight loss management groups. *Journal of the American Dietetic Association, 93*(10), 1152-6; quiz 1157-8. doi:10.1016/0002-8223(93)91648-A
- Park, C. L., Braun, T.D., & Siegel, T. (2015). Who practices yoga? A systematic review of demographic, health-related, and psychosocial factors associated with yoga practice. *Journal of Behavioral Medicine, 38*. doi:10.1007/s10865-015-9618-5
- Ramen, S., Tripathy, T. B., Mallika, K. J., Shivakumar, & Kavita, M. B. (2013). A comparative clinical evaluation of Ayurvedic diet plan and standard diet plan in sthaulya (obesity). *International Journal of Research in Ayurveda & Pharmacy, 4*(5), 680-684. doi:10.7897/2277-4343.04510
- Rapoport, L., Clark, M., & Wardle, J. (2000). Evaluation of a modified cognitive behavioural programme for weight management. *International Journal of Obesity and Related Metabolic Disorder, 24*(12), 1726-1737.
- Rippe, J. M., Price, J. M., Hess, S. A., Kline, G., DeMers, K. A., Damitz, S., Kreideih, I., & Freedson, P. (1998). Improved psychological well-being, quality of life, and health practices in moderately overweight women participating in a 12-week structured weight loss program. *Obesity Research, 6*(3), 208-218. doi:10.1002/j.1550-8528.1998.tb00339.x
- Rioux, J., & Ritenbaugh, C. (2013). Narrative review of yoga intervention clinical trials including weight-related outcomes. *Alternative Therapies in Health and Medicine, 19*(3), 46-60.
- Rioux, J., Thomson, C., & Howerter, A. (2014). A pilot feasibility study of whole-systems Ayurvedic medicine and yoga therapy for weight loss. *Global Advances in Health and Medicine, 3*(1), 28-35. doi:10.7453/gahmj.2013.084
- Ross, A., & Thomas, S. (2010). The health benefits of yoga and exercise: A review of comparison studies. *Journal of Alternative and Complementary Medicine, 16*(1), 3-12. doi:10.1089/acm.2009.0044
- Sharma, H., & Chandola, H. M. (2013). Obesity in Ayurveda: Dietary, lifestyle, and herbal considerations in R. Watson & V. Preedy (Eds.), *Bioactive Food as Dietary Interventions for Diabetes* (pp. 463-480). San Diego: Academic Press. doi:10.1016/B978-0-12-397153-1.00024-X
- Sharma, S., Puri, S., Agarwal, T., & Sharma, V. (2009). Original diets based on Ayurvedic constitution: Potential for weight management. *Alternative Therapies in Health and Medicine, 15*(1), 44-48.
- Sharpe, P. A., Blanck, H. M., Williams, J. E., Ainsworth, B. E., & Conway, J. M. (2007). Use of complementary and alternative medicine for weight control in the United States. *Journal of Alternative and Complementary Medicine (New York, N.Y.), 13*(2), 217-222. doi:10.1089/acm.2006.6129
- Shastri, K. N., & Chaturvedi, G. N. (2004). *Agnivesha, Charaka Sambhita, "Vidyotini" commentary*. Varanasi, India: Chaukhamba Bharati Academy.

- Shelov, D. V., Suchday, S., & Friedberg, J. P. (2009). A pilot study measuring the impact of yoga on the trait of mindfulness. *Behavioural and Cognitive Psychotherapy*, *37*(5), 595–598. doi:10.1017/S1352465809990361
- Shields, S. A., Mallory, M. E., & Simon, A. (1989). The Body Awareness Questionnaire: Reliability and validity. *Journal of Personality Assessment*, *53*(4), 802–815. doi:10.1207/s15327752jpa5304\_16
- Shin, H., Shin, J., Liu, P.-Y., Dutton, G. R., Abood, D. A., & Ilich, J. Z. (2011). Self-efficacy improves weight loss in overweight/obese postmenopausal women during a 6-month weight loss intervention. *Nutrition Research*, *31*(11), 822–828. doi:10.1016/j.nutres.2011.09.022
- Smith, F. M., & Wujastyk, D. (2008). *Modern and global Ayurveda: Pluralism and paradigms*. (D. Wujastyk & F. Smith, Eds.). Albany, NY: State University of New York Press.
- Wang, Y. C., McPherson, K., Marsh, T., Gortmaker, S. L., & Brown, M. (2011). Health and economic burden of the projected obesity trends in the USA and the UK. *The Lancet*, *378*(9793), 815–825. doi:10.1016/S0140-6736(11)60814-3