Published in final edited form as:

Explore (NY). 2019 ; 15(3): 230–238. doi:10.1016/j.explore.2018.11.002.

Resilient to pain: A model of how yoga may decrease interference among people experiencing chronic pain

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Abstract

Chronic musculoskeletal pain is the leading cause of disability globally, yet for the majority of people who experience chronic pain, it does not seriously disable them or interfere with their life. People who experience severe pain yet low disability display a resilient course of pain. Yoga has been shown to decrease disability among people with pain, but it is not known how. Because even the most basic yoga practices possess many of the components thought to be important in fostering resilience, yoga is a promising means of improving resilience and clinical outcomes for people with chronic pain. A validated conceptual model of how the experience of chronic pain is affected by yoga is needed to guide a future research agenda and identify potential targets for chronic pain intervention. Ultimately, an explanatory model could guide the optimization of yoga and other non-pharmacological therapies for the treatment of chronic pain. I present a testable model.

INTRODUCTION

Chronic pain is a significant public health problem in the US. It is highly prevalent, costly and potentially debilitating. Over 100 million Americans are estimated to experience chronic pain at any given time.¹ Conservative estimates place measurable loss in productivity and direct costs due to chronic pain at over \$500 billion annually.¹ For the past 25 years, back and neck pain have been the second leading cause of disease burden in wealthy nations.² Low back pain is the leading cause of disability globally.^{3,4} Despite this, the majority of people with chronic pain are not significantly disabled and their pain does not seriously interfere with their life.⁵ Much remains to be known about the factors that facilitate a low interference, resilient course of chronic pain. In particular, the severity of the pain is only a weak predictor of how much the pain interferes with meaningful life activities.⁶ Numerous lines of inquiry have independently validated the importance of psychosocial factors in the development of disabling pain.^{7–11}

Yoga is an increasingly common health practice in the United States.¹² Contemporary yoga practices are multi-modal, integrating the practice of distinct techniques including relaxation, meditation, biofeedback, stretching and exercise.¹³ Yoga has been shown to be an

Declaration of Interest: The author declares that he has no relevant or material financial interests that relate to the research described in this paper.

Data sharing: No data was used in preparing this manuscript.

effective treatment for various pain conditions.¹⁴ The evidence is strongest for low back pain.^{15,16} Even though the mechanisms of the effect of yoga on pain are not understood, yoga is a recommended therapy for conditions including chronic low back pain,¹⁷ depression,¹⁸ and hypertension.¹⁹ An estimated 10% of American adults practice yoga,²⁰ a number which has been steadily increasing over the past decade.^{21,22} Yoga practice appears to be more common among people with chronic pain than among those without.^{23,24}

It is important to understand how yoga influences pain and disability in order to correctly attribute the effect to yoga practice.²⁵ Absent a well-formulated and testable causal mechanism, researchers and clinicians may be left wondering if improvements in disability among yoga practitioners with pain is actually due to yoga, not some alternative explanation. Furthermore, understanding why yoga works in chronic pain is key to understanding how to optimize yoga for pain and to identifying what is necessary in a yoga practice for pain. Here, I present a model for how yoga practice may influence pain interference informed by a resilient coping model of pain, and a model of the relationship between personal characteristics and maintenance of yoga practice. These models are testable and could be developed with future studies.

CHRONIC PAIN

Burden of chronic pain

Pain is an evolutionarily ancient physiological phenomenon that changes an organism's behavior in the presence of actual or potential tissue damage. Chronic pain is a general term used when a patient experiences continuous or recurrent pain for an extended time, on most days for at least six months.²⁶ The most common²⁷ chronic pain complaints in US adults are low back pain, headache, and neck pain. Only rarely is chronic pain at one of these most common sites associated with an identifiable abnormality.²⁸ In some patients, the constellation of pain sites and associated symptoms is better described by a particular chronic pain condition²⁹ such as fibromyalgia or temporomandibular joint dysfunction; however, experiencing multiple co-morbid pain conditions is common.³⁰ Moreover, it is unclear that distinct chronic pain conditions represent distinct disease processes.

Pain has been poorly managed. Trends over the past decade in the US indicate that chronic pain is increasingly being managed with guideline-discordant rather than evidence-based approaches.³¹ Many pharmacological agents are available for pain, and a number are specifically recommended (e.g. in low back pain) yet their efficacy and safety profiles vary widely.³² Any particular drug therapy is at best moderately effective for a minority of chronic pain patients.^{33–37} Little is known about predicting the most effective drug for any given patient and none of the effective drugs are considered definitive treatment for the pain. The established harms of opioid therapy^{38–40} together with evidence of no higher effectiveness than non-opioid therapies⁴¹ is resulting in changing guidelines.²⁷ This creates an important need for other options.^{42–44}

Resilience in chronic pain

Resilience as a construct on its own is generally used to describe people who “do well” despite perturbations.⁴⁵ Sturgeon & Zautra propose using a specific definition in the context of pain: resilient individuals experience low levels of pain interference in the presence of high levels of pain severity.⁴⁶ In this sense, resilience factors moderate the relationship between a stressor (pain) and homeostasis (return to low pain). This does not necessarily mean that resilience requires significant stressors (i.e. a high allostatic load) but measuring resilience might necessitate that. One paradigm in resilience research posits that resilience is a natural trait of humans and that loss of resilience is pathological.⁴⁵ Much of the resilience literature is focused on psychological development and maintaining positive health outcomes as adults in the face of childhood trauma.⁴⁷

The way an individual copes with pain modifies his or her likelihood of experiencing resilient outcomes for pain. Coping strategies are the “specific efforts that people employ to master, tolerate, reduce, or minimize stressful events.”⁴⁸ This includes cognitive processes, affect/distress and behaviors,⁴⁶ as well as one’s relationships with others.⁴⁹ In this manuscript, the particular coping strategies people employ are described as either resilience or vulnerability factors. Resilience factors promote resilient outcomes and vulnerability factors hinder resilient outcomes. People inherently use a variety of both resilience and vulnerability mechanisms to face stress. Some resilience and vulnerability factors are technical skills that may be taught, learned and mastered.

Differential coping strategies have been described in a variety of ways in the literature but these distinctions have not been especially useful in understanding outcomes in pain.⁴⁸ One distinction is to separate coping strategies as adaptive versus maladaptive. This dichotomy is defined in a rather recursive way: identification of adaptive patterns of coping depends on their association with particular desirable health behaviors and outcomes, as is the case for maladaptive patterns and undesirable behaviors and outcomes.⁵⁰ This definition is problematic because the dichotomy is context-dependent: an adaptive coping strategy in one situation may be maladaptive in another. For example, avoidant coping strategies may be adaptive for youth under chronic stress,⁵¹ but avoidant coping strategies have been shown to lead to worse outcomes in the context of chronic pain.⁵² Another distinction is to separate behavioral or problem-focused coping strategies from cognitive or emotion-focused strategies. This distinction separates a person’s attempts to control the stressor itself (primary control: problem-focused) from a person’s attempts to control how she or he feels about or conceptualizes the stressor (secondary control: emotion-focused).⁵³ This distinction is helpful when a stressor may be identified as controllable or not, but is less helpful in the context of non-specific chronic low back pain as the controllable and uncontrollable aspects of the experience may be inseparable.

In the transactional model of stress appraisal and coping,⁵⁴ the unconscious or conscious selection of particular strategies individuals use to cope with stressors influences their outcomes. A person’s appraisal or perception of the stressor is as important (or more important) than any objective measure of the impact of the stressor. In the context of pain, this would mean that the way a person with chronic pain perceives the impact of pain in her or his life could be more important than an objective measure of the severity or intensity of

that pain in terms of their ultimate outcomes for pain. This fact is central to the model presented below.

Many people experience stable pain for very long periods of time (years to decades) and in response the nervous system adapts⁵⁵; in the resilience literature, attention is shifted away from simple homeostasis towards a multi-component view of outcomes. Resilient pain outcomes are of three classes: 1) recovery from the episode and returning to normal; 2) sustaining worthwhile life pursuits in the face of pain stressors; and 3) growth, which is a continual process of learning the extent of one's capabilities.⁵⁶ Theorized markers of resilient outcomes include low levels of depression and anxiety following a personal loss (recovery), maintaining elevated positive emotion and hope in the presence of a stressor (sustainability) and lower levels of depression and more elevated positive emotion than before the stressor (growth). In this sense, the outcome classes are latent constructs that are not directly measurable,⁵⁶ although several scales have been developed that quantify different aspects of growth, in the context of "posttraumatic growth."⁵⁶(fig15.1)

YOGA FOR CHRONIC PAIN

Contemporary yoga practice is a comprehensive system of lifestyle guidance that is rooted in the ancient Vedic traditions of India.⁵⁷ Physical yoga practice [*asana* in the Sanskrit writings of Patanjali] is one of the major components of the system. Practitioners move their bodies into and out of specific postures and poses with intention and attention to how they feel in the postures as well as how they feel about the process. There are many branches and schools of yoga today, highlighting the different facets of the Vedic teachings with modern iterations.^{58–60} These practices use a combination of *asana*, mindfulness [*dharana*], meditation [*dhyana*], and breath work [*pranayama*]. There is a wide variety in practitioner experiences within these diverse lineages and styles of yoga. Some of these styles are more athletic than others, some incorporate long periods of stillness and meditation, some have strict standards for instructor development and training. It is unclear what aspects of these practices make any of them more beneficial for chronic pain than others. At present, there is no evidence of particular styles of yoga being more beneficial than others.⁶¹ More athletic styles could seem inaccessible to large groups of people or practices that are particularly dogmatic and have a strong vernacular tradition may seem inaccessible to an equally sizeable group. Potentially, the most important aspect is developing self-discipline [*tapas*] to maintain a regular practice, regardless of the type of yoga practiced. Consequently, the style and yoga traditions are de-emphasized in the model below.

Yoga intervention research suffers from a problem of effect identification.²⁵ It is not always clear what authors consider "yoga" versus "not yoga" in their publications^{62,63} yet the beneficial effects may be extrapolated to "yoga." Since the definition of yoga varies, the effects of yoga do not have a consistent meaning. Possibly the effects of yoga are mediated by components that make it similar to other effective interventions, not the components that distinguish yoga. Current scholarly work on the effective components of yoga is based on expert opinion.^{64,65}

Hypothesized mechanisms of yoga in pain conditions involve the physiologic stress response and autonomic nervous system, brain changes, and physical activity and stretching.^{13,66,67} Research in yoga has demonstrated effects on the autonomic nervous system, including relaxation of the sympathetic nervous system (SNS) and hypothalamic-pituitary-adrenal axis (HPAA), major mediators of the neuroendocrine stress response.⁶⁸ Yoga practice has been shown to broadly decrease physiologic arousal, decreasing activity of the SNS and HPAA, which is implicated in the calming, relaxing effect of yoga.⁶⁹ Dysregulation of the autonomic nervous system appears to play a key role in chronic pain.⁷⁰ Arousal of the autonomic nervous system is related to how a person perceives a painful stimulus.⁷⁰ In animal models, physical activity has been shown to interrupt the development of persistent pain through its effect on autonomic dysregulation.⁷⁰ The relationship between stress, the autonomic nervous system, and recovery is complex. Other authors have hypothesized on the interrelated roles of neurotransmitters, physiological arousal, and clinical measures of the state of the autonomic system (e.g. heart rate variability).⁷¹ Much remains to be known about the likely causal upstream role of autonomic regulation in the effect of yoga on pain outcomes that is beyond the scope of this model.

There is strong evidence that some mind-body practices are modestly or moderately effective in the management of chronic pain.⁷² “Mind-body” refers to individual or group practices that recognize an integral connection of mind and body and use intentional movement or intentional stillness as a means to facilitate introspection and focus on the present. Specifically, several styles of yoga have been shown to help a variety of specific pain conditions. Encouraging awareness of the dynamic connection of the physical body and subject mind differentiates yoga from other health interventions such as physical exercise at a gym or cognitive behavioral therapy (CBT), which focus on isolated components of the mind-body connection; however, physical exercise^{73,74} and CBT⁷⁵ are both also effective in chronic pain management. It is unclear if yoga is effective in the treatment of chronic pain for the same or different reasons as physical exercise or CBT. Since yoga has similarities with both physical exercise interventions and CBT, there are likely common factors in their effect mechanisms.

One of the first randomized controlled trials in the US to test the effect of a yoga intervention in the treatment of chronic pain showed a better improvement in the yoga arm than a stretching active control arm⁷⁶; the authors suggested that the benefits of yoga may be in part due to mental focus, but that this effect would be difficult to parse out without better understanding of the mechanisms. A later study⁷⁷ by the same authors reported no significant difference between yoga and stretching on back pain-related dysfunction and concluded that the benefits of yoga are likely due to stretching and strengthening rather than any mental effects. The latter⁷⁷ of the two studies was guided by a conceptual framework^{78(fig1)} that posited several possible mechanisms for the effect of yoga. In order to examine the importance of the various potential mechanisms proposed, the authors performed a mediation analysis of the trial results.⁷⁹ They found that “total hours of back exercise” alone was only responsible for about 10–15% of the total effect of the yoga intervention arm or the stretching control arm.

Unfortunately, this type of theory-driven approach is notably rare in the field and there is no standard way of comparing yoga interventions to other effective interventions along shared components. Until recently, there has been no standard way of even describing the components of yoga interventions.⁸⁰ The field would benefit from a standardized framework that would allow investigators to test the effects of components of yoga practice on measurable health outcomes. Examining which components of yoga are responsible for (and necessary for) its effect in pain could lead to improved delivery of yoga or the development of more effective integrated interventions. Additionally, we have an incomplete understanding of what yoga practitioners actually do as a part of their yoga practice outside of interventions. The standardized framework could facilitate pragmatic population studies of how components of yoga benefit real-world practitioners. The Essential Properties of Yoga Questionnaire⁸⁰ provides one such framework for yoga researchers to score their interventions along a standardized set of practice domains. Adoption of this type of standardization will help advance research and inform theory.

CONCEPTUAL MODELS OF YOGA FOR PAIN

I propose that the ultimate effect of yoga practice on pain resilience is through its effect on key vulnerability and resilience factors, in addition to any independent effect on underlying anatomic abnormalities. These factors can further be categorized as belonging to three families of coping strategies: cognitive appraisals, psychological distress, and pain-related behaviors. This is conceptualized by a preliminary model of the impact of yoga practice on chronic pain (Figure 1). This conceptual model is based on the theory that a regular yoga practice may foster resilience in individuals with chronic low back pain by helping them develop cognitive and psychological tools to deal with the stress of pain. In the proposed conceptual model, chronic pain resilience is defined as the absence of chronic pain-related functional impairment in the presence of chronic pain.^{46,81,82} Subjective pain intensity is a weak predictor of pain-related functional impairment⁶ but greater subjective pain intensity may predict adoption of yoga practice.²³ Compared to the general US population, yoga practitioners have more baseline chronic pain and more medical complaints^{83,84}; however, evidence also suggests that yoga practice is associated with reduced risk of interfering chronic pain.^{16,85(p34)} If yoga practitioners have more pain but less interference from pain than non-yoga practitioners, yoga would be associated with pain resilience.

Model of effect of yoga on pain interference

Figure 1 presents potential vulnerability and resilience pathways through which regular yoga practice may lead to pain resilience among individuals experiencing chronic pain. The conceptual model hypothesizes that through a regular yoga practice, the person experiencing pain learns to think differently about pain (i.e., change in cognitive appraisal) and respond differently to pain (i.e., reduced psychological distress and reduced maladaptive pain-related behavior). A working definition of regular yoga practice is practicing yoga at least several times a month for 9 months out of the year. Cognitive appraisal, psychological distress, pain-related behaviors, and personality have been shown to be associated with interfering chronic pain.⁸⁶ Cognitive appraisal of pain, or how individuals perceive and think about their pain,^{87(p111)} includes pain acceptance⁸⁸ and catastrophizing.⁸⁹ Pain acceptance has been shown

to be negatively correlated with pain interference,⁹⁰ whereas catastrophizing has been positively correlated with interference.⁹¹ Psychological distress has been defined by Ridner as, “the unique discomforting, emotional state experienced by an individual in response to a specific stressor or demand that results in harm, either temporary or permanent, to the person.”⁹² Psychological distress is a latent construct that includes clinically meaningful pathologies such as depressive⁹³ and traumatic symptoms.⁹⁴ Both depression and traumatic symptoms are positively associated with disabling back pain.⁵ Finally, externalizing pain-related behaviors including illicit substance use⁹⁵ and alcohol use⁹⁶ have been shown to be associated with poor functional status.⁹⁷ The relative importance of the resilience and vulnerability factors listed above remains elusive. Since cognitive appraisal, psychological distress and externalizing pain behaviors are latent and cannot be directly measured, representative factors of each of these 3 constructs are measured as a proxy.

There is some specific evidence for how yoga practitioners are different from those who don’t regularly practice yoga in their perception of pain. Villemure et al. studied pain tolerance in a group of yoga practitioners and a group of yoga-naïve individuals.⁹⁸ Yoga practitioners had an increased tolerance to a cold pressor test (time subject tolerates hand in ice water bath) and employed different cognitions (mental strategies) during the experience. The yoga practitioners were more likely to “relax,” “accept,” “observe” the pain stress or to “breathe” during the cold pressor test. In the parlance of my model, yoga practitioners use resilience coping mechanisms when faced with a noxious stimulus when non-yoga practitioners used vulnerability mechanisms faced with the same stimulus. Additionally, immediately following yoga classes, yoga practitioners were shown to have significantly improved mood, including reporting feeling more “happy,” “relaxed,” “optimistic,” “confident” and “content” compared to before the practice.⁹⁹ Yoga practitioners develop their resilience resources through their practice. Finally, in a trial of people with chronic low back pain, after 12 weeks of yoga fewer participants in the intervention group used opiates or other analgesics in response to pain.¹⁰⁰

Does yoga instill these resilience resources in yoga practitioners or do they come to yoga already possessing these resources? Evidence is limited. Some vulnerability resources predispose people with chronic pain to have negative attitudes towards yoga. People who score high on catastrophizing and kinesiophobia scales are more likely to have negative attitudes toward yoga.¹⁰¹ Interestingly, yoga may actually benefit people with these vulnerability resources more than others because they would potentially experience the greatest changes in balance of resilience resources in favor of their vulnerability resources. Catastrophizing was associated with low mindfulness in a survey of Australians with chronic pain.¹⁰² An 8-week yoga intervention among women with fibromyalgia showed a significant improvement in pain catastrophizing in the treatment arm.¹⁰³ Yoga is recommended as an effective adjunctive treatment for depression, PTSD and occupational stress.¹⁰⁴ Fully understanding the direction of effect between yoga and the resilience and vulnerability resources will require well-designed longitudinal studies.

This model could be tested in several phases. A longitudinal study of the changes in levels of key vulnerability and resilience factors from baseline over the course of chronic pain recovery or maintenance could establish their association with pain disability. This need not

be restricted to yoga practitioners initially. Further studies would investigate the longitudinal association of yoga practice with changes in levels of the vulnerability and resilience factors during a year of regular practice. An comprehensive test of the model would randomize people with chronic pain to a yoga intervention or not and test the longitudinal association of changes in resilience and vulnerability factors with improvement in pain interference. If people improved similarly between the yoga intervention and other intervention, that would provide evidence that the mechanisms proposed above may not be the most important ones or that they are not unique to yoga. It is possible that any improvement in pain disability, regardless of yoga, may use these vulnerability and resilience factors. Such a finding would provide evidence of a broader generalizability of this model outside of yoga.

Model of relationship of mode of yoga practice with maintenance of practice

Yoga practitioners may generally be practicing independently by themselves, with an instructor, or both. To date, no evidence has emerged to explain the relative importance of these modes of practice in health outcomes or other perceived benefits. Though there may be facilitators and barriers of yoga practice broadly speaking, there may also be a unique subset of facilitators and barriers for the independent and instructor-led modes of practice. Figure 2 shows a model of the relationship between facilitators and barriers of yoga practice and maintenance of yoga practice. This model is informed by 2 other conceptual models that were presented in 2 qualitative studies of barriers and facilitators to yoga practice.

The first study¹⁰⁵ was conducted with the participants of a randomized trial¹⁰⁶ of yoga for back pain among predominantly low-income, diverse adults in Boston, MA. In their model, potential yoga practitioners (intervention participants) experience facilitators and barriers to attending yoga class. Facilitators of attending class include trusting teachers, the camaraderie with classmates and external support from family. Barriers to attending class include logistics, fear of injuring oneself in class and a lack of motivation. When the balance of facilitators and barriers is in favor to attending class, practitioners go to class. When practitioners attend class, they may perceive benefits from their practice, including enhanced mood, reductions in pain, increased self-confidence, and spiritual effects. These perceived benefits in turn act as an additional facilitator of attending class and act to decrease a lack of motivation barrier to attending class. The model creates yoga practice as a feed-forward loop that encourages further practice.

The second study¹⁰⁷ was conducted to inform methods to enhance participation in an upcoming randomized trial. In the model, certain characteristics of potential yoga practitioners (intervention participants), including their gender, race and ethnicity, religion, age, and socioeconomic status lead to an increased use of “health promoting behaviors,” which specifically are attending yoga class and practicing at home. The relationship between participant characteristics and yoga practice is moderated by (weakened or strengthened by) numerous factors, presented in a social-ecological model framework (numerous individual factors, interpersonal factors, environmental factors). The model posits that the moderating factors influence the likelihood of practicing yoga through mediating mechanisms including practitioners’ perceptions of social norms about yoga, self-efficacy to practice yoga, and social support to practice yoga. The authors specifically highlight the goals of

interventionists ought to be targeting the mediating mechanisms to increase participation in yoga.

The conceptual model here synthesizes and adds to the 2 models mentioned above. The model postulates that some characteristics may be associated with maintenance of yoga practice through their effect on adoption of any kind of yoga practice generally. Other facilitators/barriers specifically apply to certain modes of yoga practice, specifically instructor-led group practice and independent practice. For example, the social dynamics of a group yoga practice may be associated with maintenance of yoga practice generally, but only through those yoga practitioners who attend group classes with an instructor. Alternatively, some factors that may seem to be barriers to yoga may only be barriers to one mode of delivery. For example, scheduling and logistics may be an important barrier to group practice but not to independent practice. In the model, it is important to consider independent and instructor-delivered yoga modes separately to understand their relative contributions to outcomes.

In the model, a person's baseline attitudes, use of other health practices, personality and pain change the likelihood of practicing yoga. In addition, independent and instructor-led modes of yoga practice each have unique barriers and facilitators. These modes of practice have some unknown relationship with each other. Yoga may lead practitioners to develop new attitudes toward yoga, new use of other health practices, and changes in pain or other biometrics. These new characteristics may lead to maintenance of yoga practice and development of a regular yoga practice.

Future work may focus on the unique barriers and facilitators of different modes of yoga practice. Qualitative methods may be especially useful in generating rich data about these factors. The uniqueness of these factors to each mode could be assessed through surveys with yoga participants who practice in a variety of contexts. Ultimately, a longitudinal study of the role of these factors in initiation and maintenance of yoga practice could establish their causal role are facilitators and barriers of yoga practice.

Areas of controversy

No single definition of yoga is adequate for all purposes. Consequently, investigators, practitioners and clinicians may disagree on what "counts" as yoga for various purposes. As has been described above, investigators should make use of standardized ways to score their yoga interventions to elucidate the "active" or important components of yoga practice. Such an effort could help develop a meaningful, functional definition of yoga that would consider what types of practices are sufficient as therapies for various conditions. The variety of practices is beyond the scope of this model, which reflects this definitional controversy. This may in turn allow a better understanding of the dose effects of yoga, including how regularly one should practice to experience the benefits of their yoga practice.

Pain is a complex phenomenon and intensity/severity and interference/disability are only two of its numerous measurable facets. Notably, scholarship has focused on pain threshold and sensitivity as another important facet. Pain threshold is the amount or intensity of a stimulus required to evoke pain instead of painless sensation in an individual. As mentioned

above, people who practice yoga may be more tolerant to stimuli than similar people who do not practice yoga.⁹⁸ In other studies, this pain tolerance in yoga practitioners appears to correlate with different autonomic response when compared to non-yoga practitioners.¹⁰⁸ This may have important implications in understanding the role of the autonomic nervous system in pain pathophysiology and in yoga's effects in numerous pathologies with autonomic dysregulation (e.g. hypertension, diabetes, depression); however, it is entirely unclear how autonomic regulation would effect the downstream changes in vulnerability and resilience factors at the center of this model. It is also unclear if autonomic changes could occur without any downstream changes in the vulnerability and resilience factors. Consequently, the growing subject of autonomic regulation is beyond the scope of the present model, further iterations could integrate up to date knowledge.

CONCLUSION

In this manuscript, I set forth a model by which yoga may influence pain interference through its effect on key personal resilience and vulnerability mechanisms, and a model by which personal factors influence maintenance of yoga practice. The aim was to present theorized relationships between the main constructs that can be tested using data from intervention and population studies.

The next steps to test the models would be longitudinal studies that test the relationship of baseline characteristics with adoption of yoga practice, yoga practice with changing personal characteristics, changed personal characteristics with maintenance of practice, and maintained yoga practice with pain vulnerability/resilience factors. A longitudinal study of the role of pain resilience/vulnerability factors in changing pain disability would not need to be restricted to yoga practitioners but would be a critical piece in understanding the model. Through validation and testing, these conceptual models could be used to guide future interventions and directions for research. Understanding the mechanisms by which yoga influences pain interference could lead to a broader understanding of how to intervene in pain. The mechanisms may not be unique to yoga and may shed light on how to best care for pain and related conditions.

Acknowledgments:

The author thanks Erin Krebs, Sonya Brady, Dianne Neumark-Sztainer and Melissa Polusny for their critical feedback. M Donaldson was funded by an individual fellowship from the National Center for Complementary and Integrative Health, F30AT009162, and in part from an institutional training grant from the University of Minnesota Medical Scientist Training Program, T32GM008244.

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Figure 1:
Conceptual model of the impact of yoga practice on chronic pain

Figure 2:
Conceptual model of the relationship between modes of yoga practice and maintenance of yoga practice