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SPECIAL INVITED ARTICLE

YOGA AS A THERAPEUTIC INTERVENTION : A BIBLIOMETRIC ANALYSIS OF PUBLISHED RESEARCH STUDIES

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Abstract : Although yoga is historically a spiritual discipline, it has also been used clinically as a therapeutic intervention. A bibliometric analysis on the biomedical journal literature involving research on the clinical application of yoga has revealed an increase in publication frequency over the past 3 decades with a substantial and growing use of randomized controlled trials. Types of medical conditions have included psychopathological (e.g. depression, anxiety), cardiovascular (e.g. hypertension, heart disease), respiratory (e.g. asthma), diabetes and a variety of others. A majority of this research has been conducted by Indian investigators and published in Indian journals, particularly yoga specialty journals, although recent trends indicate increasing contributions from investigators in the U.S. and England. Yoga therapy is a relatively novel and emerging clinical discipline within the broad category of mind-body medicine, whose growth is consistent with the burgeoning popularity of yoga in the West and the increasing worldwide use of alternative medicine.

Key words : yoga meditation pranayama asana bibliometric mind-body medicine review

INTRODUCTION

Yoga is a practical discipline incorporating a wide variety of practices whose goal is the development of a state of mental and physical health, well-being, inner harmony and ultimately "a union of the human individual with the universal and transcendent Existence" (1). These practices are believed to have originated in early civilization on the Indian subcontinent and have been practiced historically in India and throughout East Asia. Yoga techniques include the practice of meditation,

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regulation of respiration with a variety of breathing exercises, and the practice of a number of physical exercises and postures, in which the focus is more on isometric exercise and stretching than on aerobic fitness.

A general feature of these practices is their capability of inducing a coordinated psychophysiological response, which is the antithesis of the stress response. This "relaxation response" consists of a generalized reduction in both cognitive and somatic arousal as observed in the modified activity of the hypothalamic pituitary axis and the autonomic nervous system (2). Bagchi and Wenger (3), in their early classic yoga research study wrote, "...physiologically Yogic meditation represents deep relaxation of the autonomic nervous system without drowsiness or sleep and a type of cerebral activity without highly accelerated electrophysiological manifestation but probably with more or less insensibility to some outside stimuli for a short or long time." A large number of subsequent research studies examining the effects of these techniques both in isolation and in combination have further confirmed these early results (4–9). Both short term and long-term practice of yoga techniques are associated with reductions of basal cortisol and catecholamine secretion, a decrease in sympathetic activity, with a corresponding increase in parasympathetic activity, reductions in metabolic rate and oxygen consumption and salutary effects on cognitive activity and cerebral neurophysiology.

Not surprisingly, the capability to affect psychophysiological functioning has led to the implementation of these techniques as a therapeutic intervention in a number of disorders which have psychosomatic components. Historically, this limited application of yoga techniques for specific disorders is relatively recent compared to the ancient Vedic origins of yoga (10). Gharote (1987) has stated that "the therapeutic aspect of yoga does not feature in any of the traditional systems of self-help, except in the yoga sutras of Patanjali where we come across the word vyadhi meaning 'disease' in the list of disturbing factors of mind that are obstacles to liberation. ... although yoga therapy was not a developed branch of yogic discipline as such, we do get a glimpse of the therapeutic effects of the practices in some of the hatha yoga literature such as the Hatha Yoga Pradipika. However, advice is given here within the context of practice; that is, how to deal with the complaints that arise from faulty practice" (11). In fact, since the primary goal of yoga practice is spiritual development, beneficial medical consequences of yoga practice can more precisely be described as positive "side effects" (12).

The first systematic medical application of yoga started in India in 1918 at the Yoga Institute at Versova near Mumbai, the precursor of the Yoga Institute at Santa Cruz (13). This was soon followed by the clinical work at the Kaivalyadhama Yoga Institute in Lonavala under Swami Kuvalyananda in the 1920's (14, 15). Subsequently, yoga therapy has proliferated in India with the establishment of yogic hospitals and clinics, notably the Swami Vivekananda Yoga Research Institute near Bangalore (sVYASA), and the widespread application of yoga treatments by clinicians

and yoga institutes (15–17). This trend has also spread internationally, with the appearance of yoga therapy centers, the inclusion of yoga programs in hospital cancer programs and affiliated alternative medicine centers and the establishment of a new breed of clinicians called yoga therapists, for which there are yoga therapy training programs and a society, the International Association of Yoga Therapists (IAYT), based in the United States. There are now also several dozen books available specifically on the topic of yoga therapy in general, and even on yoga therapy for specific disorders (18, 19).

The application of yoga in such a limited and strictly therapeutic manner has drawn some criticism from proponents of yoga (14), given that yoga techniques are in fact part of an ancient and sacred spiritual tradition historically applied as a holistic lifestyle discipline (20). This concern has been further aggravated by the rapidly growing popularity of yoga in the west and its subsequent commercialization and application as a trendy body slimming and fitness tool. "Postures are taught as ends in themselves merely to heal an illness, reduce stress, or look better. The fact that these postures are a foundation for self-realization is generally ignored. Yoga is often thought of as calisthenics, epitomized by the headstand, the lotus posture, or another pretzel-like pose." (21). However, from a broader perspective, both the healing of disease and spiritual endeavors share a common ground historically, in that many religious traditions incorporate a healing component. This is perhaps especially true of yoga: "Classical yoga is a source of many specific concepts and practices that promote well-being: psychophysical and spiritual. Further, Yoga is a paradigmatic system of religious therapeutics – a path of healing that serves the purpose of religious liberation. Among world traditions, classical Yoga is a useful starting point for inquiry into the relationship of medical and religious health because it connects the cultivation of physical and psychological health with spiritual well-being and exemplifies the idea of religious liberation as healing" (22). Anand (1991) has stated this more simply: "The ultimate aim of medical sciences is the attainment of optimum physical and mental health for the individual. The ultimate aim of yogic practices is also the same, viz. physical and mental well-being" (23).

Research on the psychophysiological effects of yoga practice began with Kuvalyananda's work in the 1920's, and there are a number of published reviews of this basic research literature (4, 5, 7, 14, 24). Research on therapeutic applications of yoga and meditation began more recently (14), and although there are reviews of this literature, many of these are restricted to specific disorders (20, 25–27). Furthermore, a good deal of research has been published in yoga specialty journals such as *Yoga Mimamsa*, which are not easily accessible and therefore not consistently reviewed or cited. A previous bibliometric analysis has examined publications up to 1986 on both basic and clinical research on meditation, yoga and related topics, and incorporated a variety of article types including theoretical essays, case reports, reviews and abstracts (28). The purpose of this bibliometric analysis is to identify the current full extent of the yoga therapy studies published in

research journals, including the specialty yoga publications, so as to provide an accurate survey of the best research published and examine the trends within this research discipline.

METHODS

The scope of this review will be restricted to clinical trial studies appearing in research journals, which report on interventions incorporating yoga or yoga-based techniques for the treatment of medical or psychiatric conditions or their associated symptoms. Abstracts, dissertations, reports or proceedings of meetings, and book chapters have been excluded. In a few circumstances, depending upon the extent of the information provided, brief reports or research letters in journals have also been included. Publications of case reports, case series, descriptions of treatment programs with minimal qualitative reported outcome measures, and population survey studies reporting on the prevalence of use of yoga as a therapeutic intervention have not been included.

Although meditation is an integral part of yoga practice, studies examining meditation alone without simultaneous incorporation of yogic breathing and/or specific yoga postures have not been included. This was done to restrict the scope of the review, since the meditation research literature is extensive and has been reviewed previously (9, 29–32). Notably, this criterion has excluded published research on the therapeutic application of Transcendental Meditation (TM), despite the fact that TM is in fact a yogic style of meditation and is often cited in research databases with the term "yoga" as a keyword. Also excluded are applied studies of mindfulness meditation (Vipassana) or the mindfulness-based stress reduction program (MBSR), despite the fact that MBSR utilizes yogic stretching postures as part of the intervention, although this is generally incorporated in the context of providing a focus for mindfulness. Finally, reports of applied research using other simplified forms of meditation practice such as the Relaxation Response technique, have also been excluded.

Published reports of yoga therapy research studies were first identified through searches of electronic databases, primarily Medline (Pubmed), Psychinfo and the Indian Medlars Centre database. Additional citations were also acquired from the reference sections of research publications and reviews of the literature. A concerted effort was also made to identify research studies published in yoga specialty journals, especially *Yoga Mimamsa*.

Only publications for which reprints could be acquired were subjected to analysis. Each study was evaluated as to the presence of a control group and whether subjects were randomized to different study arms, to yield 3 possible study categories: uncontrolled trials, controlled trials, and randomized controlled trials (RCT's). To avoid any influence on the analysis from any potential bias in the quality or objectivity in publications in yoga specialty journals as compared with non-yoga research journals, the analysis has been done separately for each category. Each publication was also categorized as to the disease or disorder in the subject/patient

population, the country in which the study was performed, the year of publication and the group sample sizes in the RCT's.

RESULTS

A total of 181 publications in 81 different journals published in 15 different countries were identified that met the criteria for the analysis and full reprints were acquired for all of these. A bibliography of these publications is in the Appendix. The journals with the most publications included *Yoga Mimamsa* (31), *Indian Journal of Physiology and Pharmacology* (10), *Journal of the Association of Physicians of India* (10), *Alternative Therapies in Health and Medicine* (7), *Indian Journal of Psychiatry* (6), *British Medical Journal* (5) and *Lancet* (5). In addition to these, there were 5 journals each with 4 publications, 5 with 3 publications, 8 with 2 publications, and 56 journals each with 1 publication. A total of 96 publications appeared in 27 journals published in India, 43 publications in 24 U.S. journals, 21 publications in 11 British journals and 21 publications in 19 journals from 12 other countries. A total of 34 publications were in yoga specialty journals with 31 in Yoga Mimamsa, 2 in the *Journal of the International Association of Yoga Therapists* and 1 in the *Journal of the Yoga Institute*.

An analysis of the type of studies reported (Fig. 1) revealed that 48.1% of the 181 publications were on uncontrolled studies, 39.8% were on RCT's, and 12.2% were on studies incorporating a control group that did not use randomized subject assignment. In the 147 non-yoga journal publications, the percentages were 40.1% for uncontrolled studies, 45.6% for randomized controlled studies, and 14.3% for studies with a non-randomized control group.

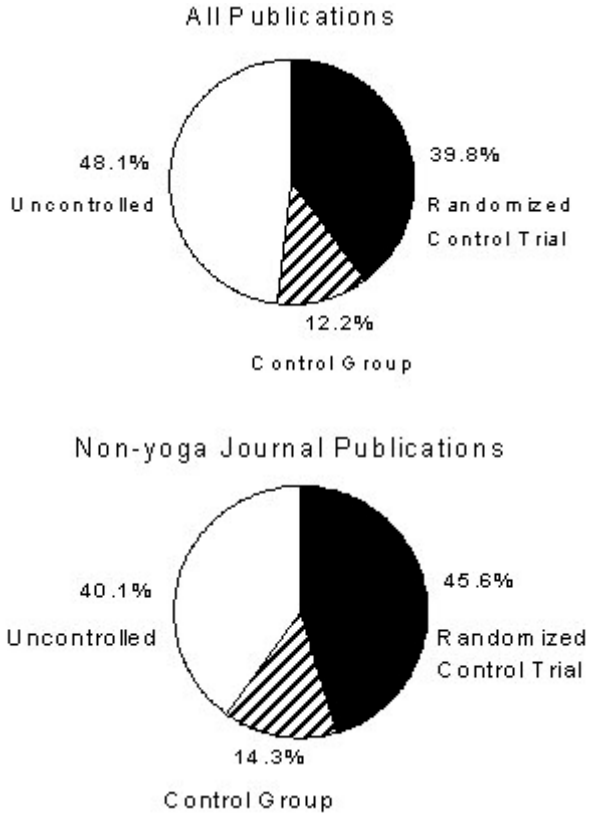

Fig. 1 : The 2 pie charts above show the proportions of all publications (top) and non-yoga specialty journal publications (bottom) that have reported on studies using RCT's, a non-randomized control group, and no control group.

Sample sizes for the separate study arms prior to the intervention and any subject withdrawal or disimpanelment were averaged for each RCT publication. From the total of 67 average sample size values, the frequency distribution for the 62 values less than 65 is shown in Fig. 2 plotted in bins of 5. Of the 5 sample size values not shown in this figure, 4 ranged from 91 to 102 and the highest was 311. The vast

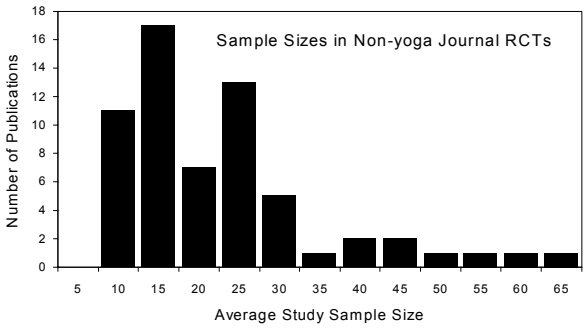

Fig. 2 : This histogram shows a distribution of the average group sample sizes for publications reporting on RCT's plotted with a bin size of 5.

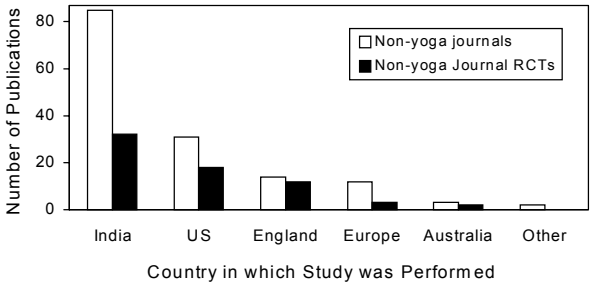

Fig. 4 : This histogram shows the distribution of the publications relative to the country in which the study was conducted for all publications, and for non-yoga journal RCT publications.

majority of sample sizes (53/67 = 70%) were 30 or less.

The chronological distribution of publication date is presented in Fig. 3 and is shown for all publications, non-yoga journal publications and for non-yoga journal randomized control trial publications in 5-year bins. Twelve publications in 2004 (5 of them RCT's) have not been included in this analysis. A gradual increase in publications is apparent up until 1989, after which the numbers appear maintained at the same level.

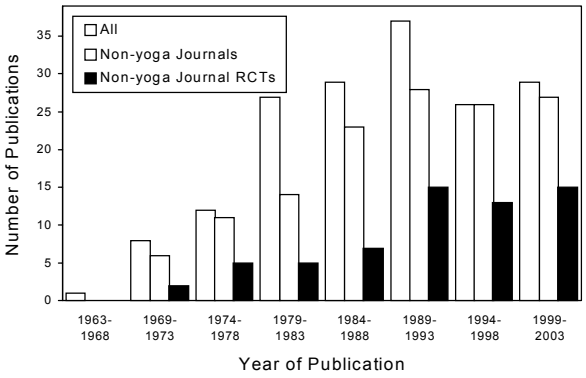

Fig. 3 : The histogram shows the chronological trend in 5-year intervals for all publications, non-yoga publications and non-yoga randomized trial publications. In all histograms, the non-yoga publications are a subset of all publications, and the non-yoga journal RCT publications are a subset of the non-yoga publications.

Results of an analysis of the countries in which the studies were conducted are shown in the bar graph distribution in Fig. 4 for the non-yoga journal studies and the non-yoga journal RCT studies. For both non-yoga journal publications and non-yoga journal RCT's, a majority of the studies have been conducted in Indian institutions (58% of all non-yoga journal publications, and 48% of all non-yoga journal RCT publications). This is followed by U.S. researchers, with fewer than half as many publications and then by investigators in England (with 9 of 14 studies published by Patel and colleagues). The 17 publications in all journals by European research groups were distributed amongst the Czech Republic and Spain (3 each), Germany, Russia, Italy and Poland (2 each) and Sweden, Yugoslavia, and the Netherlands (1 each). Countries contributing one publication each to the Other category are Canada and Singapore. The number of RCT publications in India is also greater than that of the U.S. and England. However, the proportion of all non-yoga journal publications in India that are RCT's (32/85 = 38%) is less than that of the U.S. (18/31 = 58%) and England (12/14 = 86%). Of the 34 yoga journal publications (not shown

in Fig. 3), 29 were from investigators in India, followed by Italy (2), Spain (2) and Russia (1).

The type of disorders studied were assigned to broad categories as shown in Fig. 5. About one third of the psychiatric conditions consisted of depressive disorders

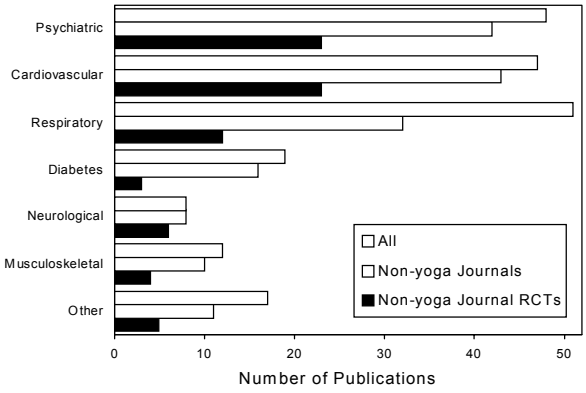

Fig. 5 : This histogram shows the distribution of the publications relative to the disorder in the study population as classified into the categories indicated on the vertical axis. Numbers of publications are shown for all publications, non-yoga journal publications and non-yoga journal RCT publications.

and this was followed in order of prevalence by anxiety, addictive disorders and then a variety of other psychopathological conditions. Cardiovascular conditions were almost evenly split between either hypertension or heart disease. Respiratory conditions were predominantly asthma, with a smaller contribution of chronic obstructive pulmonary disease and a few other respiratory conditions. Neurological conditions included mostly headache and epilepsy, whereas musculoskeletal disorders included a wide array of unrelated conditions. Analysis of all the publications was based on a total of 202 clinical study populations for all 181 publications (12 studies had 2 or more disorders), 162 clinical study populations for the 147 non-yoga journal publications (9 studies had 2 or more disorders). Within the 147 non-yoga journal publications, the discrete disorders that were studied the most were asthma (23), hypertension (21), heart disease (18), diabetes (16), depression or dysthymia (14), and anxiety (6). There were 76 clinical populations for the 67 non-yoga journal RCT publications (4 studies had 2 or more disorders).

DISCUSSION

It is unlikely that all of the yoga therapy research publications meeting criteria have been acquired. In particular, a number of Indian journals have not been indexed as well and are difficult to acquire, particularly the yoga specialty journals. Furthermore, the inclusion and exclusion criteria have been rather arbitrary, especially regarding the inclusion of techniques which are very similar to classical yoga practices. Nevertheless, it is likely that the vast majority of publications have been examined and that the general trends reported in this study are sufficiently representative.

There are a number of cautions that should be noted in interpreting this literature. There is no single standardized yoga practice format, nor is this likely or necessarily desirable in the future. There is a very wide range of the types of yoga interventions used in this literature, ranging from individual breathing or postural techniques to complete yoga lifestyle interventions involving dietary and psycho-spiritual techniques. Application of

the interventions is equally varied, from individual practice to group sessions, from daily practice sessions to weekly sessions, and from short duration to long duration sessions. Also, the quality of publications included in this review varies dramatically, with some publications presenting less material than is apparent in many abstracts. Finally, a number of publications have been reports of separate results of different outcome variables from the same study; nevertheless, these have been treated as distinct publications in this study.

From the proportion of publications reporting RCT's, it is clear that the yoga specialty journal publications, while providing valuable preliminary data, have not been as rigorous as those published in non-yoga journal publications. The fact that almost half of the non-yoga journal publications have reported RCT's is encouraging, as these trials provide the most valuable information. The sample size analysis, however, suggests that the vast majority of these studies have been small RCT's.

It is clear that published research in yoga therapy has lagged significantly behind that of basic research in yoga which began in the 1920's (28). The earliest publication meeting the criteria in this study was published in 1967 in the journal *Yoga Mimamsa* by Bhole, which was an uncontrolled study evaluating a multicomponent yoga treatment for asthma conducted at the Kaivalyadhama yoga institute (see Appendix). The first RCT publications meeting the criteria in this study were published by Vahia et al. in an Indian and a U.S. psychiatry journal (see Appendix). Both studies were conducted in India and compared active yoga treatments with inactive placebo control or pharmacological treatments in patients with anxiety and depression. The first yoga therapy publications by researchers outside of India were published by Chandra Patel and colleagues in England, who conducted a series of both uncontrolled and RCT's of yoga and biofeedback treatment for hypertension between 1973 and 1976 (see Appendix). The first publication of a yoga study (an RCT) from a U.S. research group (Hopkins & Hopkins, see Appendix) did not appear until 1979. A consistent increase in frequency of publications is apparent up to 1989, after which the frequency has been stable, suggesting the possibility of saturation or ceiling effect of productivity in this field. However, the fact that there are already 12 publications in 2004, with 5 of them RCT's, suggests that there may again be a sharp increase in the near future. This may be due in part to the recent increased interest in yoga as an alternative medical intervention, particularly in the West (33), and increased funding by government agencies such as the National Center for Complementary and Alternative Medicine in the U.S.

Clearly, the overwhelming amount of research published has come from Indian investigators. The percentages found in this analysis are similar to an estimate made in 1991 of the percentages in the entire field of yoga research (both basic and applied), which suggested that 50% of the research was performed in India (14). The predominance of Indian investigators is in contrast to the usual trend in scientific

research in which the U.S., England, Europe and Japan dominate productivity, but is perhaps not surprising given the Indian origin of yoga practice. However, many of the studies performed in India have been published in Indian journals, and peer-review procedures of some of these journals may not be as rigorous as those of Western journals. Furthermore, Indian investigators have generated proportionately fewer RCT's than their Western counterparts. This would suggest a greater effort is necessary for Indian scientists to continue moving towards improving their experimental design approaches. With the dramatic increase in popularity of yoga in the West, it is possible that Western laboratories may begin increasing the frequency of research in this area faster than that in India. For example, for the time period 1973 to 1989, the number of Indian and U.S. published RCT's was 11 and 2, respectively. From 1990 to 2004 the number of Indian-based studies was 21, a two-fold increase, whereas the number of U.S. studies was 16, an eight-fold increase.

The three types of disorders most evaluated in yoga studies have been psychiatric conditions, cardiovascular disorders, and respiratory disorders. The discrete disorders receiving the most attention were asthma, hypertension, diabetes, depression or dysthymia, heart disease and anxiety. It is likely that the choice of disorder chosen for evaluation of yoga's effectiveness has a number of contributing factors. One of these is the suitability of yoga's effectiveness in counteracting stress and reducing autonomic arousal, factors which are known to contribute to these disorders. Another factor is likely the socio-political drive to address disorders that have the highest mortality rates. In this regard, heart disease, asthma, diabetes and hypertension are amongst disorders with the highest mortality rates. It is therefore unlikely that the analysis of the types of disorders studied with yoga interventions will provide reliable information about which disorders yoga is most useful for. The appropriate study for that determination would be a meta-analysis that would evaluate relative effect sizes for yoga treatments across disorders.

It is hoped that the analysis and bibliography presented in this study has elucidated the existing research literature in this area and will support research efforts evaluating the psychophysiological effects of yoga practice, and the use of yoga as an effective primary or adjunct therapeutic intervention.

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APPENDIX

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