



Original article

Citation classics in the integrative and complementary medicine literature: 50 frequently cited articles

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Abstract

Aim of the study: The objective of the current study is to characterise the most frequently cited articles published in integrative and complementary medicine (ICM) journals.

Materials and methods: We utilised the ISI Journal Citation Reports: Science Edition 2009 database in May 2011 to determine the most frequently cited published articles. The top 50 most cited articles were selected and evaluated according to the type of journal, country of publication, topic, study design, and year of publication.

Results: The 50 selected articles were published in 7 out of 16 journals between 1980 and 2009, the majority of which originated from the US. The most common study design was literature and systematic reviews. The efficacy of ICM on pain was the most common topic, followed by the anti-inflammatory effect of ICM, prevalence of ICM utilisation, questionnaire development for pain, adverse effects of ICM, discussion of study design in ICM, chemical component of ICM, animal model testing, and obesity.

Conclusions: The findings provide a historical perspective on the scientific progress in integrative and alternative medicine. We revealed that majority papers (~60%) were published between 1995 and 2004, suggesting that ICM has gained increasing attention since 1995. In terms of study design, review-type and questionnaire-related studies constituted approximately 60% of the articles. The actual number of citations from these articles was lower than the articles from the citation classics in other medical fields. The review of the articles having the greatest public recognition could help to establish and expand the role of ICM.

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Keywords: Integrative and complementary medicine; Systematic evaluation; Citation classic

Background

Systematic evaluation of research performance has been emphasised for optimising research allocation, reorientating research support, rationalising research organisations, restricting research in particular fields, or augmenting research productivity [1]. Identifying citation classics in the field is one of the key methodologies to achieve these goals.

Citation classics were first described by Garfield for the 50 most cited papers from 1961 to 1972 [2], and is currently defined as a highly cited publication as identified by the Science

Citation Index, the Social Sciences Citation Index, or the Arts and Humanities Citation Index [3].

A higher citation rate is postulated to indicate a higher quality in spite of its original intention for use as a comparative tool of the citation rates of journal [4]. Awareness of the citation classics in a field is advantageous to identify the authors who have published significant findings on particular research topics as well as the short- or long-term impact of their work from the literary perspective [5]. Super-cited papers in medical journals also serve an important role to educate and inspire the next generation of doctors [6].

Identification of citation classics have been conducted in various medical fields, including anaesthesia [7], critical care [8], occupational health [9], ophthalmology and vision science [10], plastic surgery [11], and urology [12]. However, this type of identification has not been conducted in integrative and complementary medicine (ICM) according to our literature search. Hence, the aim of the present study is to identify and examine

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Table 1
 Summary of 16 included journals.

Title	Abbreviation	Country	Volume 1 at	Impact factor	# of top 50 cited papers
Acupuncture and Electro-therapeutics Research	Acupunct Electrother Res	US	1975	0.250	0
African Journal of Traditional Complementary and Alternative Medicines	Afr J Tradit Complement Altern Med	Nigeria	2004	0.415	0
Alternative Medicine Review	Altern Med Rev	US	1996	3.515	2
Altex-alternativen Zu Tierexperimenten	Altex-al Tern Tierexp	Germany	1984	0.922	1
American Journal of Chinese Medicine	Am J Chinese Med	US	1973	1.422	9
Chinese Journal of Integrative Medicine	Chin J Integr Med	China	1995	0.420	0
Complementary Therapies in Medicine	Complement Ther Med	UK	1993	1.950	6
Evidence-based Complementary and Alternative Medicine	Evid-based Compl Alt	UK	2004	2.064	4
Explore-the Journal of Science and Healing	Explore-Ny	US	2005	0.738	0
Forschende Komplementarmedizin	Forsch Komplemen Tmed	Germany	1997	1.281	0
Homeopathy (formerly known as British Homeopathic Journal)	Homeopathy	UK	1911	1.125	0
Integrative Cancer Therapies	Integr Cancer Ther	US	2002	1.508	0
Journal of Alternative and Complementary Medicine	J Altern Complemen Med	US	1995	1.685	12
Journal of the Australian Traditional-medicine Society	J Aust Tradit-med So	Australia	1996	0.061	0
Journal of Complementary Medicine	J Complement Med	Australia	2002	0.062	0
Journal of Manipulative and Physiological Therapeutics	J Manip Physiol Ther	US	1978	1.059	16

the characteristics of the 50 most frequently cited articles in ICM literature.

Materials and methods

The ISI Journal Citation Reports (JCR): Science Edition 2009 (Web of Knowledge) [13] was used to identify all journals whose primary or secondary categories belonged to ICM. Sixteen of the 17 journals under the group satisfied the criterion for selection. Hence, the articles from these journals were used for citation analysis. The ISI web of science (Web of Knowledge), with the Science Citation Index Expanded (1965-) and Social Sciences Citation Index (1956-), was then used to extract the top 50 cited articles within the 16 journals. All searches were conducted at the end of May 2011.

All available electronic copies of the top 50 cited articles were first collected. For those whose electronic copy was unavailable, hard copies were sought from local and overseas libraries through inter-library loan. The selected articles were collected and analysed according to various characteristics, including the publishing journal, journal country, impact factor, number of citations, topic, countries and institutions of origin (based on the first author's affiliation), year of publication, and study design. The study design was divided into the following categories: (i) prospective trials, including randomised controlled, non-randomised controlled, and uncontrolled experimental trials; (ii) observational studies, including cohort and case-control studies as well as case series; (iii) surveys including questionnaire or validation studies; (iv) basic sciences articles, including bench-top laboratory research or research involving animal models; (v) reviews including literature reviews, systematic reviews or meta-analysis; and (vi) other designs that do not belong to any of the five previous categories. The data on the publishing journal, journal country, impact factor, and number of citation were collected

from the ISI JCR: Science Edition 2009. The data on topic, countries and institutions of origin, year of publication, and study design were extracted from the article. Descriptive statistics, like frequencies, percentages, means and standard deviations, were computed.

Results

Amongst the 16 journals, 7 were from the US, 3 from UK, 2 from Germany, 2 from Australia, 1 from China, and 1 from Nigeria (Table 1). The earliest journal, *Homeopathy* (formerly known as *British Homeopathic Journal*), published its first volume 100 years ago, whereas the latest journal, *Explore: The Journal of Science and Healing*, published its first volume in 2005. The impact factors of the journals ranged from 0.061 to 3.515 according to the JCR: Science Edition 2009. During the study period from 1956 to May 2011, 11,670 articles were recorded in the database, 6799 (58.3%) of which were cited at least once. The top article had been cited 503 times, and 10 articles (0.09%) had been cited over 100 times. Table 1 also shows the breakdown of the top 50 cited articles by publishing journals. Majority of the articles were from three journals (74%), namely, *Journal of Manipulative and Physiological Therapeutics* (16 articles) [14,27–29,31,34,37–39,41–43,45,46,52,61], *Journal of Alternative and Complementary Medicine* (12 articles) [16,18,23,25,32,44,51,53,56–58,60], and *American Journal of Chinese Medicine* (9 articles) [20,30,33,35,36,47,59,62,63]. No correlation was found between impact factor and number of citations.

Table 2 summarises the top 50 cited articles in descending order according to the number of citations received by each article. The most frequently cited article, “The Neck Disability Index: A Study of Reliability and Validity” published by Veronon and Miro in 1991, received 503 citations [14].

Table 2
Description of top 50 cited articles in descending order according to the number of citations each received.

Author (Year) (Country) ^a	Title	Cited	Category ^b	Organisation
Vernon et al. (1991) (CA) [14]	The Neck Disability Index: a study of reliability and validity	503	Quest	University
Thomas et al. (2001) (UK) [15]	Use and expenditure on complementary medicine in England: a population based survey	230	Quest	University
Zhu et al. (1998) (US) [16]	The scientific rediscovery of an ancient Chinese herbal medicine: <i>Cordyceps sinensis</i> Part I	161	Review	University
Ernst et al. (2000) (UK) [17]	The BBC survey of complementary medicine use in the UK	156	Quest	University
Chainani-Wu et al. (2003) (US) [18]	Safety and anti-inflammatory activity of curcumin: a component of tumeric (<i>Curcuma longa</i>)	141	Review	University
Grant et al. (2005) (US) [19]	Benefits and requirements of vitamin D for optimal health: a review	120	Review	Research Org.
Lin et al. (1996) (TW) [20]	The anti-inflammatory activity of <i>Scutellaria rivularis</i> extracts and its active components, baicalin, baicalein and wogonin	118	Basic	University
Harris et al. (2000) (UK) [21]	The prevalence of complementary and alternative medicine use among the general population: a systematic review of the literature	111	Review	University
Lindequist et al. (2005) (GM) [22]	The pharmacological potential of mushrooms	110	Review	University
Worthington (2001) (US) [23]	Nutritional quality of organic versus conventional fruits, vegetables, and grains	109	Review	University
Nagel (2002) (GM) [24]	DarT: the embryo test with the zebrafish <i>Danio rerio</i> —a general model in ecotoxicology and toxicology	99	Basic	University
Cassidy et al. (1992) (CA) [61]	The immediate effect of manipulation versus mobilization on pain and range of motion in the cervical-spine: a randomized controlled trial	96	RCT	Hospital
Zhu et al. (1998) (US) [25]	The scientific rediscovery of a precious ancient Chinese herbal regimen: <i>Cordyceps sinensis</i> – Part II	92	Review	University
Bankova (2005) (BG) [26]	Recent trends and important developments in propolis research	91	Review	Academy
Hains et al. (1998) (CA) [27]	Psychometric properties of the neck disability index	91	Quest	University
McGregor (1991) (US) [28]	Statistical methodology for reliability studies	89	Review	University
Hsieh et al. (1992) (US) [29]	Functional outcomes of low-back-pain: comparison of four treatment groups in a randomized controlled trial	87	RCT	University
Lin et al. (1993) (TW) [30]	Evaluation of the antiinflammatory and liver-protective effects of <i>Anoectochilus formosanus</i> , <i>ganoderma-lucidum</i> and <i>gynostemma-pentaphyllum</i> in rats	86	Basic	University
Vicenzino et al. (1998) (AU) [31]	An investigation of the interrelationship between manipulative therapy-induced hypoalgesia and sympathoexcitation	84	RCT	University
Patterson et al. (2002) (US) [32]	Types of alternative medicine used by patients with breast, colon, or prostate cancer: predictors, motives, and costs	82	Quest	University
Lin et al. (2000) (TW) [33]	Antioxidant and hepatoprotective effects of <i>Anoectochilus formosanus</i> and <i>Gynostemma pentaphyllum</i>	81	Basic	University
Anderson et al. (1992) (US) [34]	A meta-analysis of clinical-trials of spinal manipulation	81	Review	University
Cooper et al. (2005) (US) [57]	Medicinal benefits of green tea: Part I. Review of noncancer health benefits	77	Review	Private Co.

Table 2 (Continued)

Author (Year) (Country) ^a	Title	Cited	Category ^b	Organisation
Wu et al. (1991) (TW) [35]	Cytotoxic activities of tanshinones against human carcinoma cell-lines	71	Basic	University
Wu et al. (2001) (US) [36]	Anti-HIV activity of medicinal herbs: usage and potential development	66	Review	University
Bolton et al. (1998) (UK) [37]	Responsiveness of pain scales: a comparison of three pain intensity measures in chiropractic patients	66	Quest	University
Boline et al. (1995) (US) [38]	Spinal manipulation vs. amitripty line for the treatment of chronic tension-type headaches: a randomized clinical-trial	65	RCT	University
Koes et al. (1992) (NL) [39]	A blinded randomized clinical-trial of manual therapy and physiotherapy for chronic back and neck complaints: physical outcome measures	64	RCT	University
Wootton et al. (2001) (US) [58]	Surveys of complementary and alternative medicine: Part I. General trends and demographic groups	63	Review	Nonprofit Org.
White et al. (2001) (UK) [40]	Clinical trials of acupuncture: consensus recommendations for optimal treatment, sham controls and blinding	62	Review	University
Koes et al. (1993) (NL) [41]	A randomized clinical-trial of manual therapy and physiotherapy for back and neck complaints: subgroup analysis and relationship between outcome measures	62	RCT	University
Beurskens et al. (1999) (NL) [42]	A patient specific approach for measuring functional status in low back pain	60	Quest	University
Coan et al. (1980) (US) [59]	The acupuncture treatment of low-back-pain: a randomized controlled-study	60	RCT	Private Co.
Walker et al. (2004) (AU) [43]	Low back pain in Australian adults: prevalence and associated disability	58	Quest	University
Vanherweghem (1998) (BL) [44]	Misuse of herbal remedies: the case of an outbreak of terminal renal failure in Belgium (Chinese herbs nephropathy)	58	Review	University
Kuo et al. (1996) (TW) [62]	<i>Cordyceps sinensis</i> as an immunomodulatory agent	57	Basic	Hospital
Vernon et al. (1990) (CA) [45]	Pressure pain threshold evaluation of the effect of spinal manipulation in the treatment of chronic neck pain: a pilot study	57	Trial	University
Robinson et al. (1987) (CA) [46]	Use of force platform variables to quantify the effects of chiropractic manipulation on gait symmetry	57	Trial	University
Lei et al. (1986) (US) [47]	Cardiovascular pharmacology of <i>Panax-notoginseng</i> (Burk) F.H. Chen and <i>Salvia Militorrhiza</i>	57	Basic	University
Patwardhan et al. (2005) (ID) [48]	Ayurveda and traditional Chinese medicine: a comparative overview	56	Review	University
MacPherson et al. (2001) (UK) [49]	Standards for reporting interventions in controlled trials of acupuncture: the STRICTA recommendations	56	Guideline	Research Org.
Zhou et al. (1990) (NL) [63]	Protective effect of danshen during myocardial-ischemia and reperfusion: an isolated rat-heart study	56	Basic	Hospital
Cooper (2004) (US) [50]	Complementary and alternative medicine, when rigorous, can be science	55	Editorial	University
Alfano et al. (2001) (US) [51]	Static magnetic fields for treatment of fibromyalgia: a randomized controlled trial	54	RCT	University
Cassidy (1998) (US) [60]	Chinese medicine users in the United States – Part II: preferred aspects of care	54	Quest	Nonprofit Org.
Gal et al. (1997) (CA) [52]	Movements of vertebrae during manipulative thrusts to unembalmed human cadavers	54	Trial	University
Yamashita et al. (1999) (JP) [53]	Adverse events in acupuncture and moxibustion treatment: a six-year survey at a national clinic in Japan	53	Quest	University

Table 2 (Continued)

Author (Year) (Country) ^a	Title	Cited	Category ^b	Organisation
Gaby (2005) (US) [54]	Adverse effects of dietary fructose	52	Review	Private practitioner
Verhoef et al. (2005) (CA) [55]	Complementary and alternative medicine whole systems research: beyond identification of inadequacies of the RCT	52	Review	University
Baillie-Hamilton (2002) (UK) [56]	Chemical toxins: a hypothesis to explain the global obesity epidemic	52	Review	University

^a AU: Australia; BG: Belgium; BU: Bulgaria; CA: Canada; ID: India; JP: Japan; NL: Netherlands; GM: Germany; TW: Taiwan; US: United States; UK: United Kingdom.

^b Category: RCT refer to randomised controlled trials; Trial refer to other types of clinical trials (e.g. pre-post trial or other trial design); Quest refer to questionnaire survey or validation of instruments; Review refer to systematic reviews, literature reviews or meta-analysis; Basic refer to basic science experimental research.

Majority of the articles (86%) originated from academic institutions [14–56], 4 articles were contributed by private/non-government organisations [57–60], and 3 articles were contributed by hospitals [61–63]. Majority of the top 50 cited articles originated from the US (19 articles) [16,18,19,23,25,28,29,32,34,36,38,47,50,51,54,57–60], Canada (7 articles) [14,27,45,46,52,55,61] and UK (7 articles) [15,17,21,37,40,49,56], followed by other European and Asian countries [20,22,24,26,30,31,33,35,39,41–44,48,53,62,63].

In terms of the study design, 19 publications were reviews including literature and systematic reviews as well as meta-analysis [16,18,19,21–23,25,26,28,34,36,40,44,48,54–58], 10 were questionnaires including surveys as well as development and validation of instruments [14,15,17,27,32,37,42,43,53,60], 8 were randomised controlled trials [29,31,38,39,41,51,59,61], and 8 were basic research [20,24,30,33,35,47,62,63].

The top 50 articles cover a wide range of topics in ICM. The two most common topics were efficacy of ICM for pain (12 articles) [29,31,34,38,39,41,43,45,51,52,59,61] and anti-inflammation (4 articles) [18,20,22,30]. Prevalence of ICM utilisation (6 articles) [15,17,21,32,58,60] was the second common subject reported, followed by questionnaire development for pain measure (5 articles) [14,27,37,42,46], adverse effects of using ICM (3 articles) [44,53,54], discussion of study design (3 articles) [28,49,55], exploration of chemical components of ICM (2 articles) [23,26], animal models (1 article) [24], and obesity (1 article) [56].

Publication period related to ICM started in the 1980s and rapidly increased after 1990, whereas the majority of the articles (16 articles) were published from 2000 to 2004. The articles that were published from 2000 to 2009 were most frequently cited. However, no correlation between the number of articles and foundation publication years was detected.

Discussion

In the present article, we identified and characterised the 50 most frequently cited articles in journals of ICM during the last 30 years. Our study found that the majority of the authors were from academic institutions in the US. This has been observed even in other citation classic papers [11,12,64,65], and may reflect that more published papers were from US-based authors in North American journals.

The top 50 articles in the field of ICM were cited between 52 and 503 times. This tally is considerably lower than the number of references attributed to general surgery (278–1013) and medicine citation classics (182–841) [64,66,67]. This discrepancy may be due to the relatively “young” ICM journals because most of them have began their publications in 1980, much later than the journals from other fields of medicine. Moreover, ICM is a relatively narrower field of interest and has a smaller audience. The results of ICM are comparatively less significant, conclusive, or generalisable. Furthermore, the impact factor of a journal related to ICM is not as high, and hence authors of ICM might tend to publish articles in mainstream journals with higher impact factors. Nevertheless, the highest cited paper [14] had over 500 citations, reflecting that articles published in an ICM journal could still attract high attention.

The publication of ICM has increased by 85% since 1990–1994 and is steadily growing. This phenomenon is coincident to the legislation passed by US Congress to provide US\$2 million for the establishment of the Office of Alternative Medicine within the National Institutes of Health to investigate and evaluate promising unconventional medical practices in 1991 [68]. This condition may have encouraged researchers to focus on ICM. Further study should explore the underlying reasons of the surge in number of publications in the 1990s.

We also demonstrated that majority of the articles had adopted literature and systematic reviews as the study design. The trend of commonly adopting reviews has been observed in ICM articles. This behaviour may be due to the fact that ICM usually involves a strong placebo effect and provider–patient interaction, so it poses a challenge of applying randomised clinical trial, which is regarded as golden standard in ICM. Surprisingly, an article using observational study design were not found. Observational study design, such as cohort and case-control, is commonly used in China to evaluate the efficacy of Chinese or alternative medicine, and the findings are usually published in Chinese journal which are not in the list in the ISI JCR. Hence, these are excluded from the search in the current paper. The common topics were the efficacy and prevalence of ICM. Pain and anti-inflammatory were the hot topics studied under efficacy, implying the complementary role of ICM to western medicine.

There are some weaknesses to our study design. First, we limited our search to those journals listed under ICM in the JCR, which could probably ignore some important journals

contributing to the field, such as *Phytomedicine* and *Phytotherapy Research*. However, the criteria that we used in the search is clearly defined and easily reproduced as there is an objective database as reference. Second, the search is based on the journals with impact factors. This criterion could preferentially favour western articles, especially from the US, UK, and Canada. For the included non-English journals, most citations to papers in languages other than English would likely be given by other papers in the same language [69]. We may lose a number of articles related to acupuncture and herbs published in Chinese and European journals. Papers with controversial conclusions may be highly cited for discussing issues, and review papers are also traditionally highly cited as they provide a summary of the research resulting in their frequent citation when introducing a topic. There are also other potential influences that may affect citation rates such as the journal and author self-citations, incomplete citing, and omission bias [12]. All of these sources of bias may interfere with the generation of a representative list of landmark articles based on absolute citation rates.

Third, considering that this collection of articles is based on objective citation data, we excluded influential papers that were not frequently cited. Some landmark papers are only cited a limited number of times until their findings became well known. This phenomenon, termed “obliteration by incorporation,” has been demonstrated in the literature of other fields [70]. In addition, we only focused on the journals related to ICM. We may limit the data analysis by excluding other non-ICM journals, but they were related to topics in ICM. A limitation of the method of ‘citation classics’ is that older papers are more likely to have been cited more, simply due to being around longer.

Despite these weaknesses, these data provide important information into how knowledge in the field of ICM has been disseminated over the last 30 years. The current study shows the important advances or public recognition in this field. ICM is evidently growing in terms of topic and research methodology onward from 1995. The common subjects are related to immunology and chronic disease, suggesting the role of ICM in the mainstream medicine. These findings encourage those in the field of ICM to conduct further influential articles/publications in future and explore the role of ICM in medicine.

Authors contributions

All research done by the authors.

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Conflict of interest

None.

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