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Mapping the Research Productivity and Scholarly Impact of the Traditional Medicine Scholars in Tanzania: A Scientometric Analysis

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Abstract

A scientometric analysis was conducted to map out the research productivity and scholarly impact of researchers at the Institute of Traditional Medicine (ITM) in Tanzania for the period between 1980 and 2013. The study analyzed the growth of the ITM's scholarly literature; ascertained the year-wise distribution of publications; determined the authorship pattern and degree of collaboration; and analyzed individual scholars' productivity and impact. Data were obtained using the Publish or Perish software that employs Google Scholar to retrieve scholars' publications and their citations. The findings show that there were a total of 381 publications published between 1980 and 2013, giving an average of 11.2 publications per year. The year 2012 had the most (12.3%) number of publications followed by 2007 and 2008 with 8.9% of all publications each. A vast majority (91.9%) of the publications were multiple-authored with 35.2% of the publications having six or more authors. The degree of collaboration was 0.92 and the ratio between team work and single author work was 11:1. Overall, M.J. Moshi and Z.H. Mbwambo were the top ranking scholars followed by R.L.A. Mahunnah and F.C. Uiso. All ITM researchers showed variation in their performance as no single scholar maintained the same rank in all nine metrics. The study findings call for scholars to recognize the importance of publishing in visible journals in order to receive large citation counts. Institutions are urged to employ scientometrics in evaluating the research performance of their scholars since such techniques take into account a combination of several measures.

Keywords: Research productivity, scholarly impact, traditional medicine, scientometrics, Tanzania

Introduction

The World Health Organization defines traditional medicine as the sum total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness (WHO, 2008). It is estimated that in some Asian and African countries, 80 percent of the population depend on traditional medicine for primary health care. In many developed countries, 70 to 80 percent of the population has used some form of alternative or complementary medicine (WHO, 2008). In Tanzania, more than 60 percent of the population use traditional therapy and medicine (Mhame *et al.*, 2004). There are approximately 80,000 traditional healers in the country, with the traditional healer to population ratio being 1:400 compared to 1:30,000 doctor to population ratio (Tambwe, 2013). Most traditional healers use mainly plants, and about a quarter of the 12,000 plant species grown in Tanzania have medicinal values (MUHAS, 2013). Given the importance of traditional medicine, research and development in this field, it is important to support and integrate traditional medicine into health systems; ensure the use of safe and effective products and practices; and ensure patient safety.

Evaluation of research performance on traditional medicine through productivity and impact studies is important in informing policies and decisions regarding the generation of herbal medicine knowledge and information. This can in turn enhance the quality of health training and health care service delivery for sustainable development. At the institution level, the research understand the research productivity and impact of individuals help to inform recruitment, incentive systems and resource allocation (Abramo, Andrea, Angelo, & Rosati, 2013). In universities, research productivity and impact studies are important for attracting and retaining highly qualified staff and research students, gaining more research funds, and improving working environment (Abrizah & Wee, 2011; Aceto, 2005), allocating facilities and gauging research activities in appropriate directions (Sudhier, 2011). Scientometric techniques are important tools for evaluating research performance of individuals, groups, institutions and countries by analyzing the quantitative and qualitative aspects of publications.

A number of scientometric studies that focus on research productivity and scholarly impact of traditional medicine have been conducted across the globe. These include scientometric studies on complementary and alternative medicine (Danell & Danell, 2009; Fu, Zhang, Zhao, Huang, & Chen, 2011; Tam, Wong, Wong, & Cheung, 2012); medicinal plants (Al-Qallaf, 2009; Anwar, 2005, 2006; Dutt, Kumar, & Garg, 2009; Fu, Zhang, Zhao, & Tong, 2012); and Chinese traditional medicine (Fu, Zhang, Zhao, & Tong, 2012; Haiqi, 1994; Leung, Chan, & Song, 2006). However, there is paucity of scientometric studies demonstrating the productivity and impact of African traditional medicine research in science. Only a few studies have been conducted on indigenous medicinal plants in Nigeria (Adelowo & Agbonlahor, 2003). In Tanzania, scientometric studies are scarce particularly on traditional medicine research. It was therefore imperative to conduct a scientometric analysis of research productivity and scholarly impact of traditional medicine scholars at the Institute of Traditional Medicine (ITM) of the Muhimbili University of Health and Allied Sciences (MUHAS) in Tanzania from 1980 to 2012.

The Institute of Traditional Medicine (ITM), previously known as Traditional Medicine Research Unit, was established in 1974. It is one of the institutes of MUHAS which became a full-fledged university in 2007, having previously been a college of the University of Dar es Salaam. The Institute plays a leading role in the development of traditional medicine by strategically creating expertise in all areas related to drug development including research and training in good practices, basic science knowledge, phytochemistry, biological testing, pre-clinical studies, clinical trials and evaluation, pharmaceutical technology, standardization of herbal pharmaceuticals, and biotechnology (MUHAS, 2013). During this study, ITM had eleven academic members of staff, three being Associate Research Professors, three Senior Research Fellows, three Research Fellows, and two Assistant Research Fellows. One Research Fellow had left the institute in 2012 but was included in this study for the years that he worked with ITM.

This study was set out to understand the research productivity and scholarly impact of traditional medicine scholars by focusing on the researchers from ITM. This was particularly important because ITM was mainly established to carry out research with a focus on traditional medicine. The study was necessary in gaining insights on the productivity and impact of traditional medicine research at MUHAS and the country in general. Specifically, the study analyzed the growth of the ITM's scholarly literature; ascertained the year-wise break up of publications; determined the authorship pattern and degree of collaboration; and analyzed individual scholars' research productivity and impact.

Overview of scientometric techniques

Scientometric refers to the "quantitative methods which are used in the analysis of science" (Nalimov, 1969). Scientometric studies are often conducted using bibliometrics, which according to Pritchard (1969), is the "application of mathematical and statistical methods to books and other means of communication, which are mainly in charge of the management of libraries and documentation centers". Scientometrics assess the research performance that individual scholars make in their field of expertise over a particular period of time by quantifying the amount of the individual publications and assessing their impacts on others published research outputs (McKercher, 2008). Therefore, scientometric evaluation remains the best method in determining the quantity of research outputs and in determining the impact of current research to other research activities. Traditionally, the quantity of research output is determined through the total number of publications produced in a given period of time whereas impact is measured by counting the number of times such publications have been cited by others.

The recent H-index bibliometric statistic is widely being used for determining research productivity and impact in a single indicator. A scientist has index h if h of his or her Np papers have at least h citations and the other (Np-h) papers have at most h citations each (Hirsch, 2005). The H-index combines quality with quantity of publications by measuring the number of publications and the number of citations per publications, whereby the most highly cited articles contribute to the *h*-index (Hirsch, 2005). It is designed to improve upon simpler measures such as the total number of publications or citations. Egghe introduced the g-index to improve h-index by according more weight to highly-cited publications (Egghe, 2006). Furthermore, Sidiropoulos and colleagues introduced contemporary h-index (Hc-index) to improve on h-index, whereby recent publications are given more weight (Sidiropoulos, Katsaros, & Manolopoulos, 2007). Another common measurement is the HI-norm index which computes the h-index of the normalized citations. It evaluates the effects of co-authorship and estimates the per-author impact (Harsing, 2013) .

The most common data sources that have been used for analyzing research performance are the Science Citation Index (SCI) introduced by the Institute for Scientific Information (ISI) in 1963, followed by Sciences Citation Index (SSCI) in 1973, and the Arts and Humanities Citation Index (A&HCI) in 1978. In recent years, new data sources such as the Web of Science, Scopus, and the Publish or Perish (PoP) software have emerged. PoP uses Google scholar to search and analyze citation counts of scholarly literature through a series of citation metrics. It analyzes raw data from Google scholar, and presents statistics such as the total number of papers, total number of citations, average number of citations per paper, average number of citations per author, average number of papers per author, average number of citations per year, the number of authors per paper, Hirsch's h-index and related parameters including Egghe's g-index, the contemporary h-index (Hc-index), and the HI-norm index. Studies have indicated that PoP retrieves more publication and citation data than other similar software (Bar-Ilan, 2008; Saad, 2006).

Literature review

Scientometric studies on traditional medicine have been conducted around the world. Such studies have either focused on complementary and alternative medicine (CAM), medicinal plants, or Chinese traditional medicine sub-disciplines. Most studies have shown that the number of publications and citations increase over time. For instance, a study of 19 CAM journals in the Science Citation Index Expanded (SCI-E) database during 1980 - 2009 indicated that there were 17,002 publications, mostly of which were published from North America, East Asia, and European countries (Fu *et al*., 2011). Similar trend was also identified by another study on most frequently cited articles published in integrative and complementary medicine (ICM) journals between 1980 and 2009. In that study, majority (~60%) of papers were published between 1995 and 2004 (Tam *et al.*, 2012). Similar findings were revealed by another study of CAM articles in the Medline database that covered the period between 1966 and 2007 (Danell & Danell, 2009). Indications are that most publications in traditional medicine gained more attention in 1990s.

Scientometric studies on medicinal plants field have also shown a consistent growth of publications and citations from 1970s onwards. Such studies include that of *Punica granatum* L (pomegranate) literature (Al-Qallaf, 2009), *Nigella sativa* (Habbat al-barakah or Black seed) literature (Anwar, 2005), *Phoenix Dactylifera* L (date palm) literature (Anwar, 2006), and medicinal plants research in India and China (Bharati & Singh, 2013; Dutt *et al.*, 2009; Gupta, Sharma, & Mehrotra, 1990). Other studies on Chinese traditional medicine also reported a substantial increase of publications and citations beginning in the 1970s onwards (Fu *et a*l., 2011; Fu, Zhang, Zhao, & Tong, 2012; Haiqi, 1994; Leung *et al*., 2006). Studies in fields other than traditional medicine have also revealed a similar trend; that research publications and citations increase over time. These include a scientometric analysis of pricing research (Leone, Robinson, Bragge, & Somervuori, 2012), Malaysians computer science scholars' research productivity (Abrizah & Wee, 2011), knowledge management literature (Serenko, Bontis, Booker, Sadeddin, & Hardie, 2010), tourism scholars research productivity (McKercher, 2008), and Chinese super-conductivity research between 1986-2007 (Zhu & Willett, 2011).

Various studies have calculated h-indices and other metrics of individual researchers. For instance, a study of medicinal plants in India and China revealed that the h-index for India citations was 57, while for Chinese citations was 56 (Bharati & Singh, 2013). A study of bio-energy scholars showed that the total number of citations was 82,732, giving a ratio for the "Average Citations per Item" as 13.83 and "H-index" as 102 (Konur, 2012). The average citation per paper and average h-index registered by the total papers of 15 Saudi Arabian pharmaceutical authors were 3.69 (varying from 1.83 to 7.47) and 9.06 (varying from 4 to 16) (Alhaider, Mueen Ahmed, & Gupta, 2013). In addition, the scientometric study of algae and bio-energy showed that the total number of citations was 11,079, giving a ratio for the ''Average Citations per Item'' as 15.45 and ''H-index'' as 52 (Konur, 2011). High scores of H-index indicate that scholars are making a significant impact on the field, while the reverse may not hold true. Low scores may also be caused by publishing in other languages other than English, limited coverage by Google scholar (Harzing & Wal, 2007), the quality of publications, visibility and accessibility of journals where one publishes, age of publications, and the size of the scientific community (Creamer, 1998; Zuckerman *et al.*, 1991).

Several scientometric studies on traditional medicine have also shown that most articles are multi-authored. For instance, a study of 19 CAM journals during 1980 - 2009 revealed that international co-authorship in the CAM field has increased rapidly during this period. In addition, internationally collaborated publications generated higher citation impact than papers published by authors from a single country (Fu *et al.*, 2011). A study of *Punica granatum* L (pomegranate) literature also revealed that most of the publications were the result of author collaboration (7l.82%), where the rate of collaboration has grown significantly from 55.6 percent during the period 1970 to 1974, to 78.3 percent in 2005 to 2006 (Al-Qallaf, 2009). A bibliometric analysis of the literature on *Phoenix Dactylifera* L (date palm) also revealed that 1,696 (69.11%) articles out of 2,454 publications were a result of collaborative effort and the number of collaborating individuals varied from two to 17 (Anwar, 2006). Anwar (2005) also reported that four-fifths of the citations on *Nigella sativa* were a result of collaborative work. Similar findings were reported in acupuncture literature where there was an increased number of collaborative papers (Fu *et al.*, 2011). Studies in other fields have also reported a high degree of collaboration among scholars (Combes, 2012; Serenko et al., 2010; Zhu & Willett, 2011).

However, Sudhier (2011) has shown a low level of collaboration among social scientists at Thiruvananthapuram from 1998-2008. High occurrence of multi-authorship might indicate a high level of established research networks among scholars.

Studies on research productivity and scholarly impact of traditional medicine scholars in Tanzania are scant. The only available studies are those on the research productivity and scholarly impact of academic librarians in eastern Africa (Ocholla, Ocholla, & Onyancha, 2012), and eastern and Southern Africa (Sitienei & Ocholla, 2010). Sitienei and Ocholla's study assessed the research and publication patterns of academic librarians in eastern and southern Africa from 1990 to 2007 by using the LISTA and WORLDCAT databases. The study found that there was no significant difference between southern Africa and eastern Africa in terms of publications per librarians. South Africa was the most productive country in terms of publications (Sitienei & Ocholla, 2010).. Ocholla *et al*'s study examined the research and publication patterns and output of academic librarians in Eastern Africa from 2000 to 2009 (Ocholla *et al*., 2012). The study found that the research visibility of academic librarians was insignificant. The most published authors were from Tanzania (Ocholla *et al*., 2012). These studies indicate that East African scholars, and particularly Tanzanian scholars publish at a low rate, publish individually, and mostly in local journals. It is therefore important to examine if the Tanzanian traditional medicine scholars share a similar publishing behaviour as compared with scholars from other disciplines in the country or region at large.

Research methods

This paper employed the Publish or Perish (PoP) software to retrieve and analyze scholarly publications published by academic members of staff from the Institute of Traditional Medicine (ITM) of MUHAS Tanzania from 1980 to 2013. This scientometric analysis was conducted in a short period of five days from 16th to 20th September 2013 for the reasons that citation counts keep accumulating with time. At first, names of researchers were obtained from ITM. There were 12 researchers in total. Included in the list were scholars who have worked with the Institute between 1980 and 2013 but have left for various reasons. Using the PoP software, the authors' productivity and impact analyses were conducted for the period between 1980 and 2013. Each of the 12 individual scholars was entered into PoP to determine their individual statistics. Citation search was carefully refined to ensure that only works of intended persons were captured and duplicates were removed. The results were sorted by years of publications in order to obtain their year-wise distribution and the total number of authors for each publication was manually counted. For each scholar, the retrieved statistics were the total number of publications, total citation counts, average citations per paper, average number of papers per author, average citations per year, h-index, g-index, Hc-index and the HI-norm.

Results and discussions

Based on the "all counting method" whereby each author receives a full count, a total of 381 publications were recorded from all ITM scientists from 1980 and 2013. The year-wise distribution of publications indicates that 2012 was the most productive year with 47 (12.3%) publications followed by years 2007 and 2008 with 34 (8.9%) publications each. The years 1982, 1983, 1986 and 1988 did not have publications at all. The average number of publications per year was 11.2 (Table 1). Generally, a significant number of publications were recorded in 2000s. Advancements in information and communication technologies particularly the Internet might have contributed to increased number of publications since 2000s; a finding that was also observed in previous studies (Danell & Danell, 2009; Fu *et al.*, 2011). It should be noted however that these publication data were extracted in September 2013; hence the total productivity of the year 2013 might be incomplete.

A vast majority (91.9%) of the publications were multiple-authored with more than a third (35.2%) of the publications being produced jointly by six or more authors. This was followed by the number of publications that were produced by five (17.6%), four (16.3%) and three (13.6%) joint authors. Single authored publications were very few (8.1%). Previous studies (Al-Qallaf, 2009; Anwar, 2005, 2006; Fu, Zhang, Zhao, Chen *et al*., 2012) have established similar authorship patterns. This high level of teamwork could due to the fact that research work is generally collaborative in nature. It might also be that traditional medicine research is highly multidisciplinary which calls for researchers from diverse fields to share their expertise. However, when a number of authors collaborate on a particular article, the actual contribution of each scholar is difficult to determine.

The degree of collaboration (C) among scholars was computed by using Subramanyan's (1983) formula. This is the ratio between the number of multi-authored papers (Nm) to the number of multi-authored publications plus the number of single-authored (Ns) publications (i.e. C= Nm/Nm + Ns). The degree of collaboration worked out for all years under review ranged between 0.33 and 1.0 with an average of 0.92 (Table 1). The ratio between team work and single author work was 11:1. These figures suggest that ITM researchers highly prefer to undertake research in collaboration in order to improve the quality of their work. Similar high level of multi-authored papers were established by other studies in medicinal plants (Al-Qallaf, 2009; Anwar, 2005, 2006). High occurrence of multi-authorship might also be an indicator of established research networks. Furthermore, multi-authored research works have a good chance of receiving many citation counts.

Table 1: Year-wise distribution of publications

Year	Number of papers per number of authors							
	Single author	Two authors	Three authors	Four authors	Five authors	Six or more authors	Total	Degree of collaboration
1980	1	0	0	0	0	1	2	0.50
1981	0	0	0	1	0	0	1	1.00
1984	0	0	1	1	0	0	2	1.00
1985	0	2	0	0	0	0	2	1.00
1987	0	1	1	0	1	0	3	1.00
1989	0	0	1	1	0	0	2	1.00
1990	1	2	4	0	0	0	7	0.86
1991	1	2	2	0	1	0	6	0.83
1992	2	0	0	1	0	0	3	0.33
1993	0	0	4	2	1	0	7	1.00
1994	0	2	0	0	0	0	2	1.00
1995	1	1	1	0	3	0	6	0.83
1996	2	3	1	1	3	0	10	0.80
1997	3	0	2	2	4	0	11	0.73
1998	0	0	0	1	1	1	3	1.00
1999	4	0	0	0	1	0	5	0.20
2000	1	3	3	1	8	6	22	0.95
2001	0	0	0	1	0	2	3	1.00
2002	3	2	1	2	4	0	12	0.75
2003	2	0	0	0	0	1	3	0.33
2004	0	2	0	2	2	5	11	1.00
2005	0	2	5	1	2	7	17	1.00
2006	1	0	3	4	8	15	31	0.97
2007	0	2	5	6	6	15	34	1.00
2008	0	3	3	11	2	15	34	1.00
2009	1	3	2	2	8	17	33	0.97
2010	1	4	0	4	3	6	18	0.94
2011	1	1	3	7	6	11	29	0.97
2012	3	0	9	5	3	27	47	0.94
2013	3	0	1	6	0	5	15	0.80
Total	**31**	**35**	**52**	**62**	**67**	**134**	**381**	**0.92**
Percent	**8.1**	**9.2**	**13.6**	**16.3**	**17.6**	**35.2**	**100**	

The mean scores for the various productivity and impact measures for all researchers were 33.2 articles, 309.4 citations, 8.58 cites per paper, 11.15 papers per author, and 17.33 cites per year. Others were h-index at 8.8, g-index at 14.8, Hc-index at 6.5 and HI-index at 4.8 (Table 2). The study findings show that these researchers had considerable variation among the productivity and impact measures as no single scholar maintained the same rank in all nine metrics. This supports the idea that multiple measures are needed when assessing the productivity and impact of scholars. Overall, M.J. Moshi and Z.H. Mbwambo tied at the first position and they both maintained the first to fourth positions in all nine metrics. R.L.A. Mahunnah and F.C. Uiso ranked number three and four respectively. R.L.A. Mahunnah maintained the third place in all metrics except HI-norm where he ranked the first and cites per year where he ranked the third. F.C. Uiso fluctuated between the first and eighth position in various metrics.

Table 2: Rank-list of authors based on various metrics

Author name	No. of publications	Citations	Cites/paper	Papers/author	Cites/year	H-index	G-index	HC-index	HI-norm	Overall rank
M.J. Moshi	76 (1)	780 (2)	10.26 (4)	20.85 (2)	31.20 (2)	17 (1)	26 (2)	13 (1)	8 (2)	1
Z.H. Mbwambo	63 (2)	985 (1)	15.63 (2)	17.38 (4)	54.72 (1)	16 (2)	30 (1)	10 (2)	8 (2)	1
R.L.A. Mahunnah	56 (3)	597 (3)	10.47 (3)	19.53 (3)	17.56 (4)	16 (2)	23 (3)	7 (3)	9 (1)	2
F.C. Uiso	19 (8)	306 (4)	16.11 (1)	6.85 (7)	9.27 (10)	10 (3)	17 (4)	4 (6)	6 (3)	3
M.C. Kapingu	27 (6)	259 (5)	9.59 (6)	6.50 (9)	15.24 (5)	9 (4)	16 (5)	6 (4)	4 (5)	4
E. J. Kayombo	34 (5)	148 (6)	4.35 (10)	22.35 (1)	6.73 (11)	6 (6)	10 (7)	5 (5)	5 (4)	5
P. Erasto	14 (11)	141 (7)	10.07 (5)	6.23 (10)	17.63 (3)	5 (7)	11 (6)	6 (4)	4 (5)	6
P.J. Masimba	13 (12)	121 (8)	9.31 (7)	3.00 (12)	15.13 (6)	6 (6)	11 (6)	6 (4)	3 (6)	7
J.J. Magadula	39 (4)	113 (10)	2.83 (11)	13.59 (5)	12.56 (8)	6 (6)	8 (8)	6 (4)	3 (6)	8
E. Innocent	26 (7)	121 (9)	4.65 (9)	7.32 (6)	12.10 (9)	7 (5)	10 (7)	6 (4)	3 (6)	8
R.S.O. Nondo	14 (10)	106 (11)	7.57 (8)	3.37 (11)	13.25 (7)	5 (7)	10 (7)	5 (5)	3 (6)	9
J. N. Otieno	17 (9)	36 (12)	2.12 (12)	6.81 (8)	2.57 (12)	3 (7)	5 (9)	4 (6)	2 (7)	10
Mean	33.17	309.42	8.58	11.15	17.33	8.8	14.8	6.5	4.8	

Note: Numbers in brackets are the scholars' ranks on that particular measure

In ranking the scholars based on the number of publications, M.J. Moshi was the most productive author with 76 publications followed by Z.H. Mbwambo (63 publications) and R.L.A. Mahunnah (56 publications). When scholars were re-ranked based on the number of citations, Z.H. Mbwambo ranked the first (985 citations) followed by M.J. Moshi (780 citations) and R.L.A. Mahunnah (597 citations). Interestingly, F.C. Uiso who had a comparatively low number of publications (19 publications), had received many (306) citation counts and moved up from the 8^{th} place to the fourth. This suggests that her publications were received well by other scholars. On the contrary, J.J. Magadula who ranked number four in terms of publications, dropped to number 10 in relation to citation counts. These findings confirm the fact that one's citation counts depend on many factors other than the total number of publications. Such factors include the quality of publications, visibility and accessibility of journals where one publishes, author's integration into scientific networks, age of publications, and the size of the scientific community (Creamer, 1998; Zuckerman *et al.*, 1991).

With respect to the scholars' yearly impact which is obtained by dividing the total number of citations by the number of years, Z.H. Mbwambo ranked number one with 54.72 cites per year, followed by M.J. Moshi (31.20 cites per year) and P. Erasto (17.63 cites per year). By dividing the citation counts by the total number of publications, which indicates the average impact of individual publications, F.C. Uiso ranked the first followed by Z.H. Mbwambo and R.L.A. Mahunnah with 16.11, 15.63 and 10.47 cites per paper respectively. In terms of researcher's individual impact (papers/author) which is computed by dividing each paper by the number of authors for that paper and then adding up the fractional author counts, another scholar E. J. Kayombo moved up to occupy number one followed by M.J. Moshi and R.L.A. Mahunnah with 22.35, 20.85 and 19.53 papers per author respectively (Table 2).

The scholars were also ranked based on various indices. With respect to the h-index which is regarded as the most robust and accurate measure of productivity and impact (Harzing, 2008), M.J. Moshi had the highest h-index of 17. This means that his 17 papers had been cited 17 or more times each, and the rest of the papers had fewer than 17 citations. Z.H. Mbwambo and R.L.A. Mahunnah ranked the second with h-indices of 16 each and F.C. Uiso ranked the third with h-index of 10. Once the h-index was improved by giving more weight to the authors' highly cited publications, Z.H. Mbwambo had the highest g-index at 30 followed M.J. Moshi and R.L.A. Mahunnah with g-index at 26 and 23 respectively. This means that g-index has a greater power to distinguish publications with higher impact making it easier to differentiate the performance of authors. By making adjustments in order to give more weight to newly published works (Hc-index), M.J. Moshi (Hc-index at 13) ranked the first followed by Z.H. Mbwambo (Hc-index at 10) and R.L.A. Mahunnah (Hc-index at 7). With regard to the HI-norm-index which adjusts the total citations by the number of authors, R.L.A. Mahunnah moved to the first position with HI-norm index of 9. M.J. Moshi and Z.H. Mbwambo were tied at the second position with indices of 8 each and F.C. Uiso ranked the third with HI-norm index at 6.

Conclusion and implication of study findings

The study findings have shown a growing trend in ITM's publications during last three decades. The most productive year was 2012 followed by 2007 and 2008. The findings also showed a high level of teamwork with most publications being produced jointly. The average degree of collaboration was very high (0.92) and the ratio of team work to that of sole work was 11:1. This high level of teamwork is attributed to the multidisciplinary nature of traditional medicine research which calls for sharing of expertise. These researchers showed considerable variation in various metrics since no single scholar maintained the same rank in all nine metrics. This supports the fact that multiple measures are needed when evaluating the productivity and impact of scholars. The overall ranking indicate that M.J. Moshi and Z.H. Mbwambo were the top ranking scholars and they maintained the first to fourth positions in all nine metrics. R.L.A. Mahunnah and F.C. Uiso ranked number two and three respectively. On the whole, this study shows that scientometric analysis provide a complete picture of research productivity and citation impact of scholars in the given field and it maps out the evolution of the research field.

The implications of the study findings are two-fold. Firstly, the findings call for scholars to recognize that it is important to publish a substantial number of papers in journals that are widely visible such as e-journals and particularly open access journals in order to receive many citations. This is particularly important because the use of scientometrics in evaluating research performance has become prominent across the world (Konur, 2012). Scientometric studies can form a basis for recruitment, promotion, tenure and workload decisions. Secondly, the fact that there was variation in various productivity and impact measures suggest that many measures should be considered in combination when evaluating research performance of individuals instead of relying on single indicators such as the number of publications.

The limitation of this study is that it only focused on publications and citations that that were retrieved by Google Scholar search engine. This means that publications and citations that were not available on the web in one way or the other could not be retrieved. In addition, data for this study were extracted in September 2013; hence the total productivity of the year 2013 might be incomplete. The present study can be improved by including more scientometric parameters and conducting a comparative study involving all traditional medicine publications in Tanzania or Africa as whole.

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