

Trends in biomedical research in Namibia: 1995-2009

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Abstract

Research publications are often used as proxies for the scientific progress and development of a particular country. Country-specific bibliometric studies reflect national strategies to build capacity in tertiary education, research, and health services. In Namibia, no study to date has analyzed trends at the country level. The aim of this study was to evaluate the biomedical publication patterns in Namibia between 1995 and 2009. Using the keyword 'Namibia' in PubMed and ISI Web of Knowledge, resulting papers were hand searched for information on subject areas, types of studies undertaken, first authorship patterns, and institutions involved in biomedically-focused publications. This study identified 450 publications between 1995 and 2009. Only 129 (28.6%) involved Namibian authors. Just over half (58%) of the studies were carried out in Namibia but varied dramatically by subject area. 52% of Namibian-authored papers were Namibian first-authored with a decreasing trend since 2004. Only 7.5% (34) of the publications involved authors from Namibian universities. Namibia has a strong potential to develop in biomedical research but there is a need for tertiary institutions to modify current policies, continue to diversify sub-areas and become equipped to build capacity with local and international collaborators.

Keywords: *Bibliometrics, biomedical science, publication productivity, Namibia,*

Introduction

Research publications are valuable indicators of scientific progress and development, especially when evaluating the status of a particular country (Dandona [1], Benamer [2,3], Bissar-Tadmouri [4], Noden [5]). As publications are the result of individual scientists or 'webs' of both foreign

and local collaborators (Newman [6]), 'bibliometrics' (the scientific analysis of research productivity) is a popular means of assessing a country's research strategy (Bakoush [7]). By studying the patterns of publication, it is possible to identify individuals and research entities within a country which can assist in identifying local issues and design studies to answer specific questions (Pouris [8]).

There are many forms of bibliometric studies with those particularly focused on regions or individual countries the most popular for a variety of reasons. Regional studies compare between countries and highlight which country is publishing the most and attempt to identify the reasons (Bissar-Tadmouri [4], Rosselli [9], Neves [10], Uthman [11], Hofman [12], Uthman [13]). Country-specific bibliometric studies focus on particular research topics ([Dandona [14], Aaron [15]), the output of various medical schools (Benamer [3]), university faculties (Gulluoglu [16], Dakik [17]), the author and the identity of publishing units (Noden [5]) or biomedical publication patterns (Benamer [2], Bakoush [7], Neves [10]). Studies which focus on the research output from a specific country reveal trends in national strategies which encourage and build capacity in the institutions and the personnel involved in tertiary education, in research, and in the health services to do nationally important research [Benamer [2], Rosselli [9], Neves [10], Gulluoglu [16], Thompson [18], Nwagwu [19], Abramo [20]). Namibia has been a fertile ground for a wide variety of biomedical research (Noden [5]).

While most Namibian authors since Independence in 1990 have published once, there is great potential in the variety of publishing institutions if research could become more part of the biomedical culture (Noden [5]). The purpose of this publication, then, is to analyze the biomedical research production in Namibia, identifying subject areas, types of studies undertaken, and authorship patterns involved in biomedically-focused publications between 1995 and 2009. The overall goal was to provide a baseline from which future studies can be compared.

Methods and materials

On July 3, 2010, during a one hour period, data was collected for all publications between 1995 and 2009 using 'Namibia' as a key word in PubMed and ISI Web of Knowledge (Thompson Reuters) search engines.

PubMed is a MEDLINE-linked search engine which provides access to 20 million biomedical citations and considered the 'most optimal' tool in biomedical electronic research (Falagas [21]). ISI Web of Knowledge is a citation database provided by Thomson Reuters with multidisciplinary coverage of over 10,000 high-impact journals in the sciences, social sciences, and arts and humanities. While PubMed is an open search engine, the author had access to the ISI Web of Knowledge through an adjunct position at Illinois State University. It is notable that PubMed and ISI Web of Knowledge do not index all journals which may publish Namibian-related studies. However, they index the most cited journals which would have the highest opportunity to be read by an international audience (Pouris [8]). The reasons for evaluating only publications during the 15 year time period, the inclusion and exclusion criteria, and a detailed description of how the papers were manually checked to ensure quality has already been described by Noden [5].

Study details

Four main **study types** apparent during data collection were: a) 'travel studies' – studies which focused on travelers to Namibia who returned home with a medical issue; b) 'Namibian studies' – studies which were carried out in Namibia including both those entirely completed in Namibia and those in which the experimental work was done in Namibia but the analysis and writing were done elsewhere, c) 'sample studies' - studies which collected samples in Namibia but examined, analyzed and wrote the study up elsewhere, and d) 'data sets' – studies taken from published Namibian data sets (usually available online) and analyzed individually or part of a larger regional or global study.

'**Study focus**' describes how the data/materials gathered from Namibia were used: a) 'Namibian' focused on those studies entirely completed in Namibia and those in which the experimental work was done in Namibia and samples taken abroad for testing, analysis and writing; b) 'Regional' included studies using data collected either in Namibia or from Namibian data sets and were compared with other regional samples in the Southern Africa region (geographically this included Zimbabwe, Zambia, Angola, Botswana, Mozambique, Swaziland, Lesotho, and South Africa); c) 'Sub-Saharan Africa' (SSA) were those comparing Namibian data to other SSA countries; d) 'global' were those comparing Namibian data or samples to other samples taken from different countries around the world.

First authorship was assigned to general region: Asia, Europe, Middle East, North America, Southern Africa, and Namibia based on the address provided. Authorship identification methods were described earlier.

Subject areas described relied on the PubMed categorizing system. Where discrepancies occurred between the two search engines, keywords used were evaluated separately and subject area was determined. Articles were grouped into 7 main categories to aid in analysis: 1) biomedical, medical, and pharmacological; 2) ecology, evolution, or systematics; 3) public, occupational, or environmental health; 4) veterinary or animal science or zoology; 5) social science (biomedical in focus); 6) marine science; and 7) environmental science (soils, radioactivity).

Results

Search Engine Comparisons

A total of 513 papers involving 'Namibia' were identified by PubMed and/or ISI Web of Knowledge search engines between 1995 and 2009 (Table 1). Of those, 63 studies were identified using 'Namibia' but were not used. 41(65.1%) were studies which did not directly involve Namibia. These included studies of animals long-time removed from Namibia in European zoos, Namibians moved years earlier to South Africa, authors based in Namibia but writing on studies done in other countries, Namibian reference samples taken years before with no other reference to Namibia in the paper, or Namibia only mentioned in passing in the Discussion. 16 (25.4%) were mislabelled, studies from neighbouring countries or completely carried out in other countries but incorrectly labelled as Namibian studies in the keywords. The remaining 6 (9.5%) papers consisted really of 2 papers found only in PubMed which were double and triple referenced. It is noted that the double reference has since been corrected since this data was collected.

Table 1: Differences between Pubmed and ISI Web of Knowledge in regards to biomedical subject areas being searched for between 1995 and 2009.

Subject	Both (%)	Pubmed (%)	ISI Web (%)	TOTAL
Biomedical, Medicine, Pharmacology	38 (79)	8 (17)	2 (4)	48
Ecology/Evolution/Systematics	47 (40)	9 (8)	61 (52)	117
Environmental science	26 (96)	1 (4)	0 (0)	27
Marine science	4 (40)	2 (20)	4 (40)	10
Public, Occupational, Environmental health	89 (67)	40 (30)	4 (3)	133
Social science (biomedical)	8 (89)	1 (11)	0 (0)	9
Veterinary/Zoology/Animal science	76 (72)	7 (7)	23 (22)	106
TOTAL	288 (64)	68 (15)	94 (21)	450

For the subject areas evaluated, the majority of papers were found in both search engines (Table 1). The majority of ecology, evolution, and systematics papers were found only in ISI Web of Knowledge as well as a significant number of marine science papers. Notably, 74.2% of the 62 papers not found in ISI Web of Science used completely different identifying keywords than PubMed. The remaining 25.8% (16) used the keyword 'Multidisciplinary' to identify the subject of the publication as opposed to specific keywords used in PubMed.

Subject areas

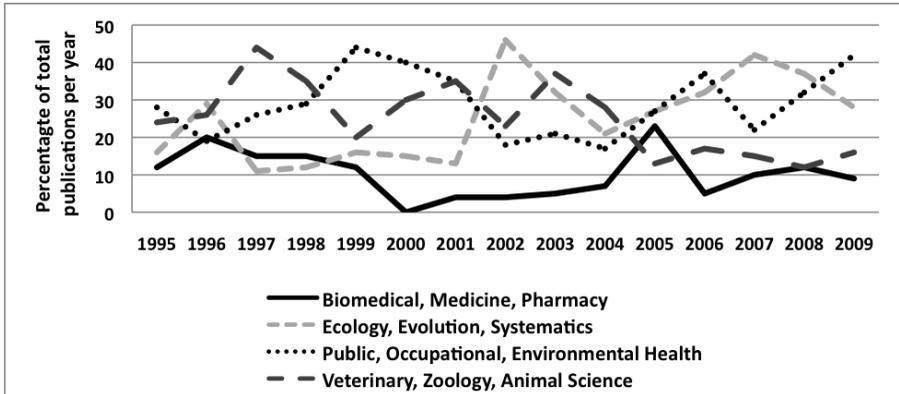


Figure 1. Total percentages of articles in the four major subject areas by year¹.

¹The areas of marine science, environmental science, and social science were not included in the figure due to having such small contribution.

Figure 1 details the annual total proportions of articles in the four principle subject areas by year. Other subject areas monitored in this analysis provided too few publications to meaningfully include in the figure – environmental science (27 publications – 6% total), marine science (10 publications – 2.2% total), and social science/anthropology (9 publications – 2% total). General patterns observed with studies involving animals decreased over the 15 year period (44% of all publications in 1997 to 12% in 2008) and ecology/evolution related studies increased (11% of all publications in 1997 to 42% in 2007). While public, occupational, and environmental health publications were cyclical (averaging 29% of all publications with peak of 44% and 41.9% in 1994 and 2009, respectively, and low of 17% in 2004), Biomedical articles averaged 10% reaching a high of only 23% in 2005 and a low of no publications in 2000.

Study type

Figure 2 details the proportions of publications in subject areas by study type during 1995-2009.

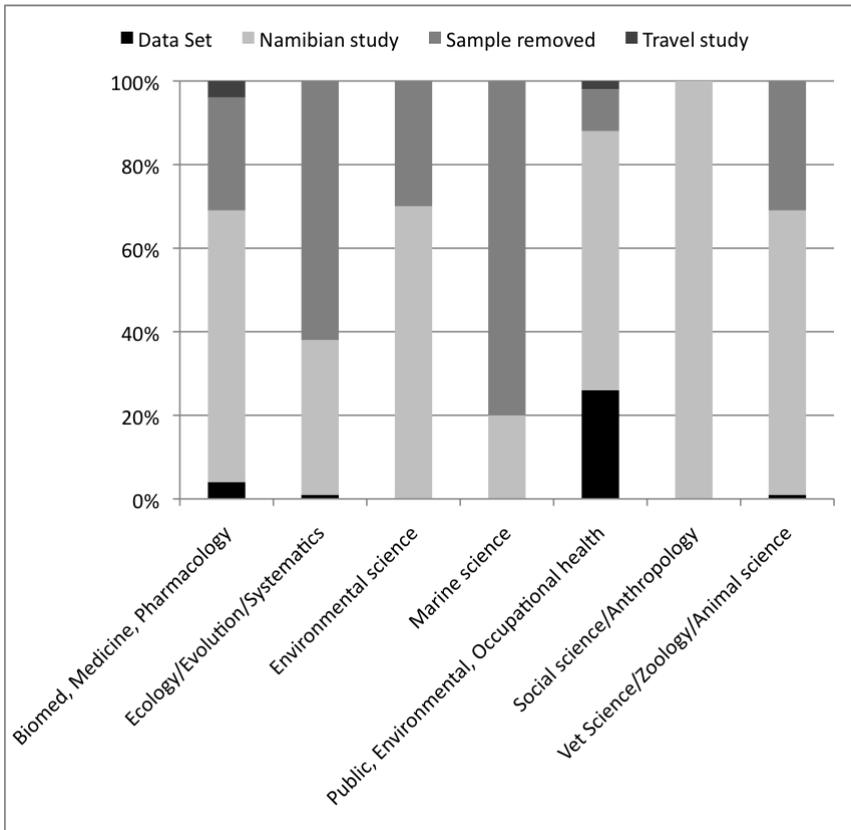


Figure 2. The percentages of publications in subject areas by study type 1995-2009.

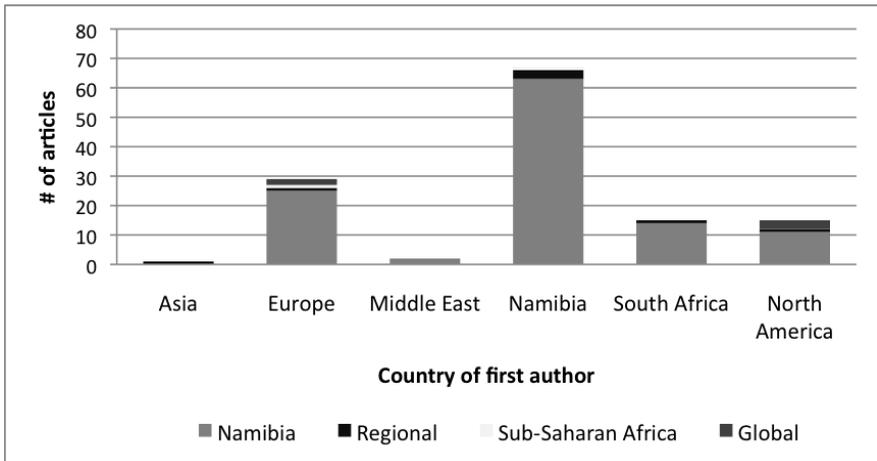
The slightly over half of the studies (58%) were carried out in Namibia, varying by subject area: 100% of social science/anthropology, 70% of environmental science, 68% of veterinary/animal studies, 65% of Biomedical/medicine/pharmacology, and 62% of public, occupational and environmental health. 33.1% of all studies involved removing samples from Namibia. Removed samples accounted for a high percentage of publications for marine science (80%), ecology/evolution (62%) and veterinary/animal science (31%). 'Data set' studies accounted for 8.4% of all publications with the majority (89.5%) focused on public, occupational, or environmental health. Biomedical, medicine and pharmacological articles had the highest proportion of 'travel studies' (1% of the total publications).

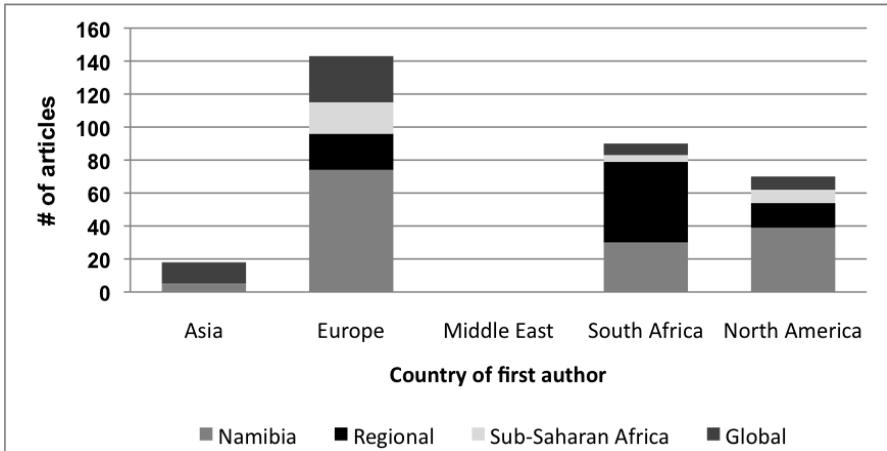
Authorship comparisons

Of the 450 papers analyzed between 1995 and 2009, 129 (28.7%) involved Namibian authors. Of publications first authored by Namibians, 94% were Namibian-focused studies with the rest regional or SSA-focused (Fig 3a). Comparing first authorship trends, the slightly over half (51.9%) of Namibian-authored papers were first-authored by Namibians (Fig 3a) whereas the papers with no Namibian authors were first-authored by Europeans (45.5%) followed by South Africans (28%) or North Americans (21.8%)(Fig 3b). Interestingly, only one (a regional study) of 19 studies by Asian authors involved a Namibian author (Fig 3a). 5 (26.3%) of 19 Asian-authored papers were completed in Namibia with the remaining 13 involving genetic comparative studies with samples removed from Namibia (Fig 3b). 54.4% (49) of the 90 papers first-authored by South Africans with no Namibian involvement were regional, using data sets secured from Namibia (Fig 3b).

Figure 3. Comparison of study focus by articles involving Namibian authors and those where no Namibian authors were involved between 1995 and 2009.

a) First authorship of 129 articles involving Namibian authors.





b) First authorship of 321 articles involving no Namibian authors

Regarding authorship, the majority of Namibians involved in publications were part of studies carried out in Namibia (95.3%) while 6 involved data sets or samples removed from Namibia for further analysis (Fig 3a). All but one Namibian first authored study was carried out in Namibia compared with Namibian studies organized by authors based in Europe (55.8%), South Africa (43.8%) and North America (57.6%) (Fig 3b). A large proportion of studies involving samples removed from Namibia were first authored by South Africans (48.6%), Europeans (32.6%) or North Americans (28.2%) (Fig 3b).

Figure 4 details the annual percentage of publications involving Namibian authors with special emphasis on Namibian first-authored papers.

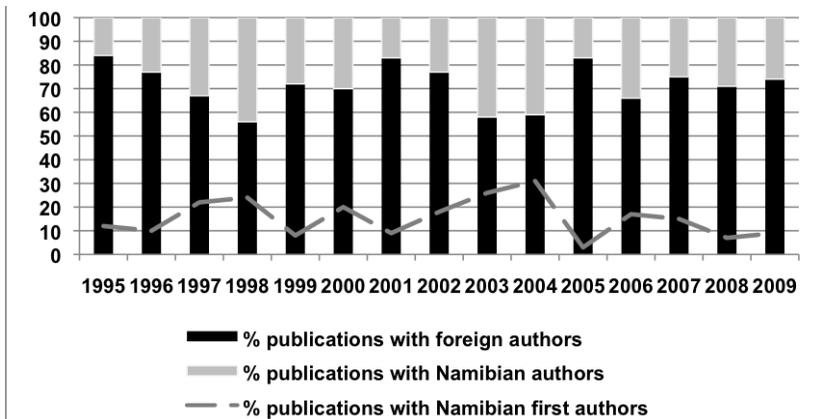


Figure 4. Percentages of papers by authorship between 1995 and 2009. The figure demonstrates total % of annual publications involving Namibians. Between 1995 and 2009, the average annual percentage of papers including Namibian authors was 28.5% with lows of 16% (1995) and 17% (2005) and highs of 44% (1998), 42% (2003) and 41% (2004). Interestingly, the trend did not change in the last 4 years (2006-2009).

The 129 papers authored by Namibians involved 280 different authors (Table 2). When comparing the publishing institutions, almost an equal number were from Centers of Higher Learning, Government related Ministries, and Private organizations/NGOs. Most authorship by Namibians was as co-authors (68%) followed by first-authored papers (25%). Only 7% of Namibian authored papers were by single authors.

Table 2. Authorship by general category of institutions

Research Institutions	1st Author (n)	Single author (n)	Co-author (n)	TOTAL (n)	% of total
Centres of Higher Learning	28	13	45	86	31%
Government Related	19	1	85	105	37%
Private/NGOs	22	5	62	89	32%
TOTAL	69	19	192	280	100%
% of total	25%	7%	68%	100%	

Discussion

The results of this study were encouraging as they demonstrate that Namibian institutions and authors are involved in biomedically-related research with strong potential for growth and development. First, this study demonstrates that there is a high diversity of subject areas which already have baseline studies on which Namibian research can develop. In the past 15 years,

44 institutions involving 190 Namibian-based authors have contributed to research which has resulted in at least one paper (Noden [5]). The publication rate of Namibia is on par with the rest of the continent (Hofman [12]) as well as the world ([Perez-Iratzeta [22]), contributing 0.01% of the total number of biomedical publications in Sub Saharan Africa (SSA) (Hofman [12]). This publication rate is also in line with the Gross National Product (GNP) and total population of the country (Uthman [11]), one of the main predictors of biomedical research productivity in developing countries ([Perez-Iratzeta [22]).

Secondly, the majority of Namibian-focused biomedically-related publications were found using PubMed. This is a great advantage as ISI Web of Knowledge or other search engines need subscriptions for access. Pubmed provides access to 20 million biomedical citations and is considered the 'most optimal' tool in biomedical electronic research (Falagas [21]). While the searching component is encouraging, the lack of access to journals continues to be a challenge for Namibian scientists as it is for other developing countries ([Goehl [23], Koehlmoos [24]). At the time of writing, Namibia has received Band 1 [free] HINARI coverage. However, because of arrangements made before 2012 with private institutions, Namibia's HINARI does not provide access to Elsevier and Springer journals. Namibia is considered an 'upper-middle income country' by the World Bank [25]. While Namibia's GDP might be high when divided by a low population (GNI per capita, Atlas method - US\$ 4,270) (The World Bank [25]), Namibia is also known to have the highest Gini coefficient in the world (CIA [26]). The Gini coefficient is commonly used as a measure of inequality of income or wealth. Around the world, Gini coefficients range from 0.23 (Sweden) to 0.70 (Namibia) (CIA [26]). This means that most of the wealth remains with a very small proportion of the population. This works out in reality to approximately half of the Namibian population living below the international poverty line of US\$1.25 a day (49.1% - 2009 figures). With 52% unemployment, 90% of persons have no access to health insurance (2008 figures) (CIA [26]). This 'upper-middle income country' label in Namibia considerably undercuts the potential for biomedical research to develop as it affects funding formulas for grant proposals as well as access to information.

Another encouraging factor is that a majority of Namibian authors were part of studies completed in Namibia. The majority of these publications were

multi-authored papers with Namibians as first-authors. This encourages the research process in Namibia to go a step further and complete the whole study, including the analysis and writing, in Namibia. This is much in line with developing global trends in co-authorship patterns in the sciences [Bissar-Tadmouri [4], Bartneck [27]]. This trend comes with an encouraging reduction in single authored publications and an increase in collaborative efforts by Namibians and foreign-based scientists in the past 4-5 years (Noden [5]).

Along with these encouraging factors, there were a number of concerns. Most notably is the observation that 3 out of every 4 papers published involving Namibia did not involve Namibian authors. It isn't clear why this happened although lack of infrastructure, limited priority by various institutions involved, a significant focus on 'systemic research' in the Ministry of Health and Social Services (MOHSS) (Tugwell [28]), and a lack of capacity to finish studies carried out in Namibia may all play a role. There is a need to study where the research process is struggling and take steps to ensure the whole research process, including the analysis and writing, is able to take place in Namibia. It is difficult to address this matter as funding often comes with a quick endpoint. Often, with foreign funding, the priority is to get the study completed and written up in as short a time as possible, leaving Namibian authors out of the final stages. The commitment for this should come from those funding the study as well as all researchers involved. While building capacity can be tedious, this is one of the main underpinnings which have created strong independent biomedical research communities in other African countries (Killeen [29], Laabes [30]).

Related to this issue of authorship, a disturbing trend indicates that first-authorship in Namibia has been decreasing since 2004 while Namibian co-authorship is increasing (Figure 4 and Noden [5]). The first author usually is the person who envisions, carries out, analyzes and writes up a study. It involves persons who have experience in the whole research cycle. The fact that Namibian first-authorship is decreasing indicates that either non-Namibians have stepped in to do most of the work or there is a lack of capacity among Namibian authors to finish a study to the publication stage.

Together with authorship trends is the trend to remove samples from Namibia for testing, analysis and publication, particularly in marine science, ecology/evolution and veterinary/animal science. This is most likely due to a lack of

infrastructure and trained personnel to complete the work in the country. Again, the solution comes from an agreement by both funding agencies and Namibian institutions to not only get the information disseminated but see research as a whole process which needs capacity building.

Tertiary education involvement

The results revealed the essential need for Namibian tertiary institutions to grow into their roles as centers of biomedical research excellence. In the past 15 years, only 7.5% (n=34) of the 450 biomedically-focused publications involved authors from Namibian tertiary institutions (University of Namibia (n=33) and Polytechnic of Namibia (n=1)). Biomedical, medical, and pharmaceutical articles averaged 10% of all publications annually. While, admittedly, this study did not identify all possible search engines where authors may have published, both engines provide access to the most important biomedical journals which are accessed by the international community.

While appearing troubling, there is a logical explanation for this skewed statistic. Since independence in 1990, most of the tertiary level biomedical training for Namibians has taken place in South Africa. In 2008, training programs for medicine, pharmacology, and veterinary science were initiated at UNAM and biomedical laboratory science and environmental health at the Polytechnic of Namibia. At the time of writing, these programs have a strong dimension of research built into their curriculums. It is hoped that with this training and focus on research, there will be more contribution to biomedical research by Namibian tertiary institutions in the future.

As Namibian institutions build their biomedical capacities, there is also need to evaluate how that research will be empowered. As of 2011, there is a lot of excited talk about research in these newly developing programs in Namibian universities. However, without a dramatic change of existing policies, it is unlikely the universities will be able to attain significant levels of influence. For example, multiple authorship on biomedical studies needs to be highly encouraged at both universities, even to the level of incentives. Also, there is a dramatic need to address the teaching and service overload experienced by competent and talented researchers in Namibian universities (Noden [5]). As long as the multi-disciplinary approach to research, freeing researchers to develop, is not rewarded in the promotional schemes of both

Namibian universities, it is highly unlikely that the cross-pollination of ideas will produce the fruits which come from dynamic local and international collaborations (Noden [5]).

While all attempts have been made to reduce various limitations, some are unavoidable. First of all, it is difficult to identify the country where authors of various studies resided during the study. Some studies, particularly those originating in South Africa, may have Namibian authors but because the study was done in South Africa, the addresses provided are South African. Even though all attempts were made to identify the addresses of each author, it is not possible to know how many were missed. Secondly, because of the small sample size used, this study only evaluated quantity of papers and did not use impact factors to evaluate quality (Benamer [3], Gulluoglu [16]). Finally, potential authorship and institutional information contained in the 'grey literature' in the archives of government offices and NGOs was not available on the internet and hence, lost to the parameters of the study.

In conclusion, the study identified that Namibia clearly has a strong potential to develop in biomedical research. An encouraging diversity of studies carried out by Namibians in the past 15 years has been published in journals accessed by using PubMed. The concern, however, is that the researchers are not being fully equipped as a result most studies are being lead and written by foreign-based collaborators. There is an exciting mandate for Namibian tertiary institutions with developing Biomedical training programs to modify current policies, diversify sub-areas, strengthen their IRB capacity and become equipped on all levels to build capacity together with local and international collaborators. These modifications will do much for both tertiary education institutions to realize their potential as the catalysts for change in the Namibian research environment. Until those changes occur, however, Namibia's researchers and centers of research excellence will never reach their potential.

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