

Article

Clinicians' Publication Output: Self-Report Survey and Bibliometric Analysis

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Abstract: The uncertainties around disease management and control measures have not only motivated clinicians to keep abreast of new evidence available in the scholarly literature, but also to be rigorously engaged in medical research, dissemination and knowledge transfer. We aimed to explore clinicians' publication output from the Malaysian perspective. A self-report survey and bibliometric analysis was conducted. A total of 201/234 clinicians participated in the survey. Items consisted of demographics, researching habits, publication output and level of importance of journal selection metrics. Descriptive, bivariate and multivariate analyses were conducted. Bibliometric analysis using retrieved records from PubMed between 2009 and October 2019 was conducted and co-occurrence and co-authorship analyses were executed. Self-reported publication output was 16.9%. In the logistic regression model, publication output was significantly higher amongst consultants or clinical specialists (aOR = 2.5, 95% CI 1.1–10.0, $p = 0.023$); clinicians previously involved in research (aOR = 4.2, 95% CI 1.5–11.4, $p = 0.004$); clinicians who ever used reference citation managers (aOR = 3.2, 95% CI 1.3–7.7, $p = 0.010$); and journal publication speed (aOR = 2.9, 95% CI 1.2–7.1, $p = 0.019$). Most clinicians published original research papers (76.4%) in international journals (78.2%). Published papers were mostly observational studies, genetic, stroke and health services or systems research. In conclusion, socio-demographics, researching habits and journal selection metrics were significantly associated with self-reported publication output. Real outputs from bibliometrics were predominantly focused across five clusters.

Keywords: medical publishing; research; Malaysia

1. Introduction

Rapid urbanization and industrialization have posed tremendous challenges to clinicians globally to deal with complex clinical environments to manage disease uncertainties, control disease risk factors and cope with population ageing. While clinicians constantly strive to explore new diagnostic and interventional tools to enhance patient care, they struggle to battle the complications of new disease outbreaks that present unprecedented concerns to international health. An example is the recent Zika epidemic which triggered a global healthcare workforce deployment to tackle the complications of congenital microcephaly in newborns [1], Guillain–Barre syndrome (GBS), meningoencephalitis and transverse myelitis in adults [2] with courage and harmonization. Central to this uncertain contagion, healthcare workers worldwide came together and were able to communicate across national borders through rapid data sharing of new and critical information that emerged consistently through medical publishing that was made openly accessible by major publishers. These phenomena have shown

clinicians that medical publishing is imperative to disseminate novel scientific discoveries for effective knowledge transfer.

Evidence Based Medicine (EBM) has forced clinicians to incorporate up-to-date information from clinical trials into their practices for effective patient care and disease management. Marusic advocated the triads of “professional must” for clinicians to be engaged in medical publishing [3]. It was postulated that knowledge is the property of mankind, thus upholding information reliability and professional education is important to bridge current gaps of knowledge deficit in clinical practice [3]. Active engagement in medical publishing of applied research can provide a conduit for accelerated translation of basic science to clinical practice.

The latest UNESCO Science Report highlighted five emerging countries in East Asia as science power houses that have invested greatly in scientific research. Apart from mainland China and Japan being the giants of scientific output generation, Malaysia’s publication volume rose rapidly, overtaking Hong Kong and Singapore within the past decade [4]. In line with the paradigm shift from disease to risk, the Ministry of Health Malaysia (MOH) has aggressively promoted medical research through the establishment of the National Institutes of Health (NIH). These institutes would assume a central role to support research activities and scientific productivity related to disease burden and clinical trials among clinicians [5]. A network of Clinical Research Centres (CRCs) were established nationwide in major hospitals within the MOH facilities to accommodate the national target of achieving 1000 clinical trials by 2020, in addition to the acceleration of public health and clinical epidemiological research to establish efficient control measures and current healthcare needs of the country [6].

From the Malaysian perspective, research in academia and research in the rise of the clinician-scientist spectrum have been set against one another. However, to become a reflective clinician-scientist with the core competencies of medical publishing skills, clinicians are required to have the ability to interpret the scientific literature, demonstrate competence in research methods and appraise statistical analyses accurately for application in clinical practice [7]. Clinicians should be prepared to encounter the obstacles of medical publishing ranging from high rejection rates, unfavourable reviews, lack of time, journal indexing, costs and publishing models to a race against the scientific publication avalanche [8–10].

Measuring scientific publication quantity and quality is important for conceptualising the research impact of an individual and the nation [11]. Bibliometric and scientometric analysis has been the fundamental of measuring scientific productivity. While bibliometric indicators like impact factors [12] or Scopus have been used to assess an individual’s scientific productions or thematic fields in emergency medicine [13], cardiology [14] and orthopaedics [11], geospatial scientometrics have evaluated scientific productions across cities [15] and administrative regions [16]. While these indicators have exhibited global institutional trends of publication output, they are limited by the focus of geographical area and other specific medical fields. These parameters also failed to evaluate attributes of the individuals that influence the success of publishing a scientific paper in the scholarly literature. As Malaysian scientific productivity is fuelling innovation towards a research nation, this preliminary investigation was aimed at exploring scientific publication output and its associated factors among clinicians from a Malaysian research hospital.

2. Materials and Methods

2.1. Study Sample and Setting

This study adopted a two-design descriptive-observational approach. The first part was a cross-sectional self-report survey among all 234 practicing clinicians attached to our hospital. The second part was a bibliometric analysis of retrieved records from PubMed on clinicians’ scientific publication output between 2009 and October 2019. The study was conducted at the Seberang Jaya Hospital, a cluster-lead research hospital located in mainland Penang, northern Malaysia, that actively conducts various health-related research and clinical trials for the improvement of healthcare

delivery [17]. The hospital oversees and administers three other satellite district hospitals and ten primary care clinics within the region, collectively catering to a population of about 900,000 people simultaneously [6]. Apart from providing core patient care and speciality medical services, it is one of the most active prime sites for clinical trials and medical research in the northern region of Malaysia [17]. Medical research is mainly handled by clinicians, pharmacists and nurses through the established CRC within the hospital. Currently, there are 36 CRCs, which form a network across general public hospitals nationwide. These centers are maneuvered by the Institute of Clinical Research (ICR) housed at the NIH, the recent landmark for medical and healthcare research in Malaysia [5,6]. All clinicians (medical officers and clinical consultants or specialists) from the medical, surgical and its allied based departments were approached during Departmental Continuous Medical Education (CME) sessions. Permissions and assistance from the relevant head of departments were obtained.

2.2. Ethics Approval

This study complied with the guidelines convened in the Declaration of Helsinki. The research protocol was approved by the Medical Research Ethics Committee (MREC), Ministry of Health Malaysia (government approval number: NMRR-18-64-39559 IIR). Objectives and benefits of the study were explained verbally and in written form attached to the survey. Respondents were assured that information obtained would be confidential. A written consent was obtained from those who agreed to participate.

2.3. Measures

All clinicians completed a self-administered survey that included items on demographics, researching habits, publication output and level of importance of journal selection metrics to publish a paper. The questionnaires were administered in English, given our sample cohort consisting of professional practicing clinicians who preferred communicating in English that was in line with their routine medical practice. Real output from bibliometric analysis was conducted using PubMed database.

2.3.1. Demographics

Demographics data included gender, age, clinician level, current field of medical practice and occupation type. Occupation type was categorized into two categories (consultants or clinical specialists and medical officers) according to the pre-defined profession grades and clinical roles as legislated by the Malaysian Public Service Department (PSD) [18]. We defined young clinicians as those who had obtained their national medical register license less than 10 years ago (Grades UD44 and UD48), while senior clinicians were defined as those who had obtained their national medical register license 10 or more years ago (Grades UD52, UD54, UD56 and JUSA) [18,19]. The professional grades for clinicians are time-based. Entrance into public medical service starts from resident-ship (designated as Grade UD41—we excluded this group as they were provisionally registered with the clinical service). After two years of successful resident-ship they become fully registered junior clinicians with the designated Grade of UD44, and three years later, these clinicians are automatically promoted to Grade UD48. After five years of service in clinical practice, these clinicians are designated to Grade UD52. Clinicians further become Grade UD54 after nine years of service for specialists or twelve years later for non-specialists. The time-based service promotion ends here. They may be promoted further to higher speciality of Grades UD56, JUSA C, JUSA B or JUSA A based on service necessity, importance and higher level of administration as designated by the Public Service Department of Malaysia [18].

2.3.2. Primary Outcome Measure

For the primary outcome measure, we defined scientific publication output as scholarly publications limited to case reports, reviews or original research papers [20]. Reviews were limited to systematic reviews, meta-analysis, scoping reviews or rapid literature reviews and excluded book reviews. Clinicians' self-reported publication output was assessed with a single dichotomous question,

“Have you published a scientific work like case report, review or original research paper during your clinical practice?” with response options of “Yes” or “No”. In addition, descriptive bibliometric analysis was conducted for records retrieved from the PubMed database by exploring search affiliation “Hospital Seberang Jaya” between 2009 and October 2019.

2.3.3. Researching Habits

Five items that evaluated clinicians’ researching habits include previous involvement in research; having ever used a reference citation manager like ReadCube/Mendeley/EndNote/Zotero; having ever used statistical packages like SPSS/STATA; awareness of major indexing databases like PubMed/Scopus/EBSCO/PsychInfo; and awareness of Belmont Principles and Helsinki Declaration of ethical considerations with dichotomized response options of “Yes” or “No.”

2.3.4. Journal Selection Metrics

The final part assessed the level of importance of journal selection metrics (nine items) considered by clinicians to publish a scientific paper. Items of the validated metric attributes were adapted and modified based on a previous reported approach: (1) Peer reviewed; (2) open access; (3) submission to publication speed; (4) impact factor; (5) manuscript acceptance rate; (6) journal indexations; (7) local journal; (8) international journal; and (9) reputable editorial board [9]. These domains were measured on a five-point Likert scale ranging from 1 [least], 2 [less], 3 [neutral], 4 [great] and 5 [greatest]. Items were dichotomized into two categories: “least,” “less” and “neutral” as “lesser;” “great” and “greatest” as “greater” to ease interpretation.

2.3.5. Pilot Testing and Veracity

Parts of the survey items were adapted from previously published studies, Khan et al. [9], Bonilla-Escobar et al. [20], Niwa et al. [21] and Bovijn et al. [22], with additional items being added to further conceptualise our study objectives and sample characteristics. The questionnaire was pre-piloted prior to data collection to assess its comprehensibility and ease of completion. Questionnaire validity was evaluated during verbal debriefing sessions. No significant content changes were made following the conclusion of the pilot phase. To ensure only clinicians’ publication outputs were analysed from the bibliometric analysis of the PubMed database, the author or co-author names were checked with the Malaysian Medical Register [19], papers with authors’ names who are clinicians (as appeared in the medical register) were included.

2.3.6. Visualizing Variable Associations

A framework was constructed to visualize the associations between variables of interest (Figure 1) by using the Directed Acyclic Graph (DAG) method, plotted by DAGitty (<http://dagitty.net/>) [23].

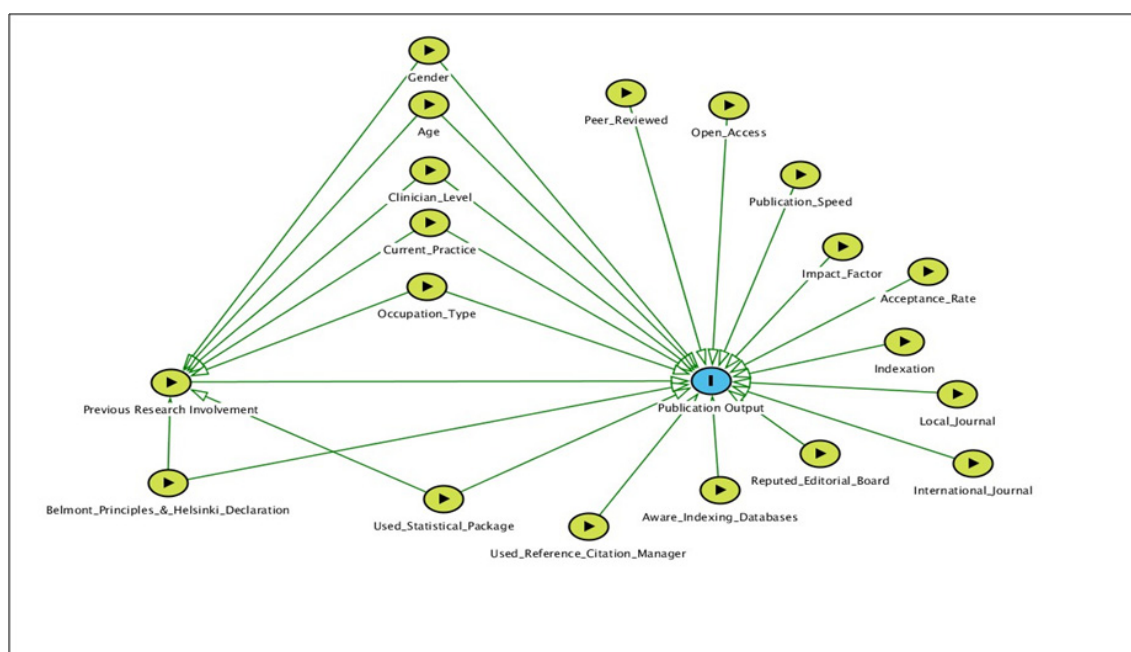


Figure 1. A Directed Acyclic Graph (DAG) of the factors of interest in the analysis. The outcome variable is identified as a blue oval with a black frame; exposures are identified as a green oval with a black frame.

2.4. Data Analyses

2.4.1. Analyses of Self-Report Survey

Data collected were analysed using SPSS version 23.0. All quantitative data were found to be normally distributed using statistical and graphical methods. Descriptive statistics were conducted for all variables. Chi-square test was used to assess the associations between publication output and categorical variables in this study. Multiple logistic regression analysis using “enter”, “forward” and “backward” regression techniques were employed to determine the factors associated with clinicians’ publication output. Variables selection was systematic according to the constructed DAG, and entered into the multivariate regression analysis based on statistical significance ($p < 0.05$) at bivariate level, principles of parsimony and model fitness. Multi-collinearity between independent variables was checked for the values of the variation inflation factor (VIF) not exceeding 10. The most parsimonious final regression model was selected and presented. Statistical significance was set at $p < 0.05$.

2.4.2. Bibliometric Analyses

Bibliometric analyses were conducted for real output of retrieved references from the PubMed database between 2009 and October 2019. Descriptive analysis for publication output in terms of total number of publications by clinicians, inequalities within subject categories, journals and author productiveness were explored using BibExcel software. Co-operation network and keyword co-occurrence analysis was conducted using VOS viewer software with relevant radar charts being yielded.

3. Results

3.1. Sample Characteristics

Two hundred and thirty-four clinicians were invited to participate in the study and 201 (85.9% response rate) participated. The study participants consisted of 77 (38.3%) men and 124 (61.7%) women. The mean (SD) age of the clinicians was 32 (5) years, with a range of 26–54 years. The majority of the

clinicians, 111 (55.2%) were older than 30 years old. Most were young clinicians, 166 (82.6%), attached within the medical and allied specialties, 82 (40.8%). Most clinicians were medical officers, 163 (81.1%), who were previously involved in research, 106 (52.7%) (Table 1).

Table 1. Clinicians' Socio-Demographic Characteristics and Researching Habits ($n = 201$).

Characteristics	n (%)
Gender	
Men	77 (38.3)
Women	124 (61.7)
Age group (years)	
≤30	90 (44.8)
>30	111 (55.2)
Clinician level	
Young clinician	166 (82.6)
Senior clinician	35 (17.4)
Current practice	
Medicine and allied	82 (40.8)
Surgery and allied	75 (37.3)
Others	44 (21.9)
Occupation type	
Consultants/Clinical specialists	38 (18.9)
Medical officers	163 (81.1)
Previous involvement in research	
Yes	106 (52.7)
No	95 (47.3)
Ever used reference citation manager like ReadCube/Mendeley/EndNote/Zotero	
Yes	38 (18.9)
No	163 (81.1)
Ever used statistical package like SPSS/STATA	
Yes	122 (60.7)
No	79 (39.3)
Aware about major indexing databases like PubMed/Scopus/EBSCO, PsychInfo	
Yes	137 (68.2)
No	64 (31.8)
Awareness of Belmont Principles and Helsinki Declaration	
Yes	41 (20.4)
No	160 (79.6)
Published a scientific paper	
Yes	34 (16.9)
No	167 (83.1)

3.2. Clinicians' Researching Habits

The majority of the clinicians had never used a reference citation manager 163 (81.1%) but had explored statistical packages like SPSS or STATA 122 (60.7%). The bulk of clinicians were aware of major indexing databases 137 (68.2%) but were unaware of the Belmont and the Helsinki Declaration of ethics principles 160 (79.6%). Self-reported publication output among clinicians in this sample was 16.9% (Table 1).

3.3. Clinicians' Journal Selection Attributes

Most clinicians emphasized greater importance on the following journal selection attributes for publishing a scientific paper: Open access, 111 (55.2%); submission to publication speed metrics, 110 (54.7%); impact factor, 132 (65.7%); manuscript acceptance rate, 114 (56.7%); local journal, 106 (52.7%); international journal, 140 (69.7%); and reputable editorial board, 133 (66.2%). Less than half of the

clinicians emphasized greater importance on peer reviewed journals and indexations, constituting 45.8% and 40.8%, respectively (Table 2).

Table 2. Clinicians Journal Selection Attributes ($n = 201$).

Characteristics	n (%)
Peer reviewed	
Lesser	109 (54.2)
Greater	92 (45.8)
Open access	
Lesser	90 (44.8)
Greater	111 (55.2)
Submission to publication speed	
Lesser	91 (45.3)
Greater	110 (54.7)
Impact factor	
Lesser	69 (34.3)
Greater	132 (65.7)
Manuscript acceptance rate	
Lesser	87 (43.3)
Greater	114 (56.7)
Journal indexations	
Lesser	119 (59.2)
Greater	82 (40.8)
Local journal (Malaysian)	
Lesser	95 (47.3)
Greater	106 (52.7)
International journal	
Lesser	61 (30.3)
Greater	140 (69.7)
Reputable editorial board	
Lesser	68 (33.8)
Greater	133 (66.2)

3.4. Bibliometric Analysis

A total of 55 records were retrieved from the PubMed database between January 2009 and October 2019. These include original research papers, 42 (76.4%), reviews, 11 (20%) and case-reports, 2 (3.6%). Twelve papers (21.8%) were published in Malaysian journals, while the rest, 43 (78.2%), were works published in international journals. The top five journals with most published papers were The Medical Journal of Malaysia (10.9%), Medicina (Kaunas) (7.3%), Malaysian Orthopaedic Journal (5.5%), Plos One (3.6%) and Malaysian Journal of Medical Sciences (3.6%). With regards to co-authorship analysis, a total of 308 authors from 28 clusters were identified to publish the retrieved 55 records from the institution. The most productive authors from the institution were Irene Looi (14 papers), Kurubaran Ganasegeran (nine papers) and Hor Chee Peng (seven papers). Publication output of authors from the institution that linked to co-authors is exhibited in Figure 2.

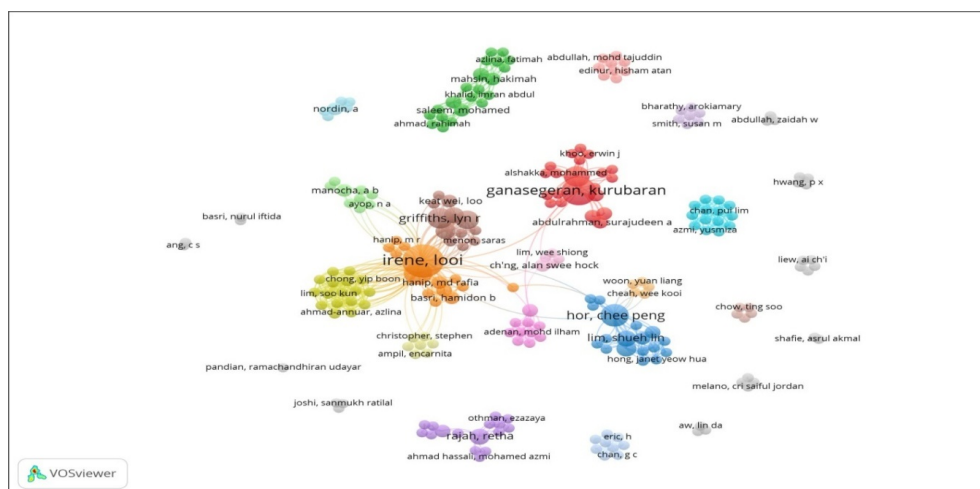


Figure 2. Radar chart showing network of clinician's co-authorships of publication output. Threshold set at ≥ 1 publication. The size of the circle represents the density of productivity output and the thickness of the connecting lines represents collaboration strength.

Keywords analysis of MeSH terms revealed 41 items that were clustered into five groups which amounted to a total of 238 occurrences. MeSH defined as Medical Subject Headings is used by both MEDLINE/PubMed and ClinicalTrials.gov for indexation of medical articles and classification of diseases that are being studied in clinical trials, respectively. It was crucial to use MeSH terms for bibliometric analysis in this study given the study objectives that intend to analyze publication output related to medical research or clinical trials conducted by a selective group of samples, namely practicing clinicians in our hospital. Table 3 describes the clusters, probable concepts derived from the clusters and frequency occurrence of each item. The network visualization map of co-occurrence of authors' MeSH terms is exhibited in Figure 3.

Table 3. Frequent Keywords and Cluster Conceptualizations.

Cluster	Concepts Group	Keywords Occurrence
1 (19 items)	Observational studies involving human subjects	Humans (33), female (19), male (16), adult (13), aged (11), middle aged (11), young adult (9), prospective studies (7), cross-sectional studies (6), surveys and questionnaire (6), aged 80 and above (5), retrospective studies (4), adolescent (4), child (3), pregnancy (3), neoplasm staging (2), c-peptide (2), perception (2), pharmacists (2)
2 (9 items)	Genetic related studies	Polymorphism, single nucleotide (4), asian continental ancestry group (3), case-control studies (3), genetic predisposition to disease, alleles (2), genetic association study (2), genotype (2), odds ratio (2), parkinson disease (2).
3 (6 items)	Stroke research	Stroke (7), brain ischemia (5), registries (4), risk factors (4), hypertension (2), lifestyle (2).
4 (5 items)	Health services and systems research	Primary health care (4), health personnel (3), emergency service hospital (2), communication (2), health knowledge, attitude, practice (2)
5 (2 items)	Overlap cluster	Chi-square distribution (2), polymorphism, genetic (2)

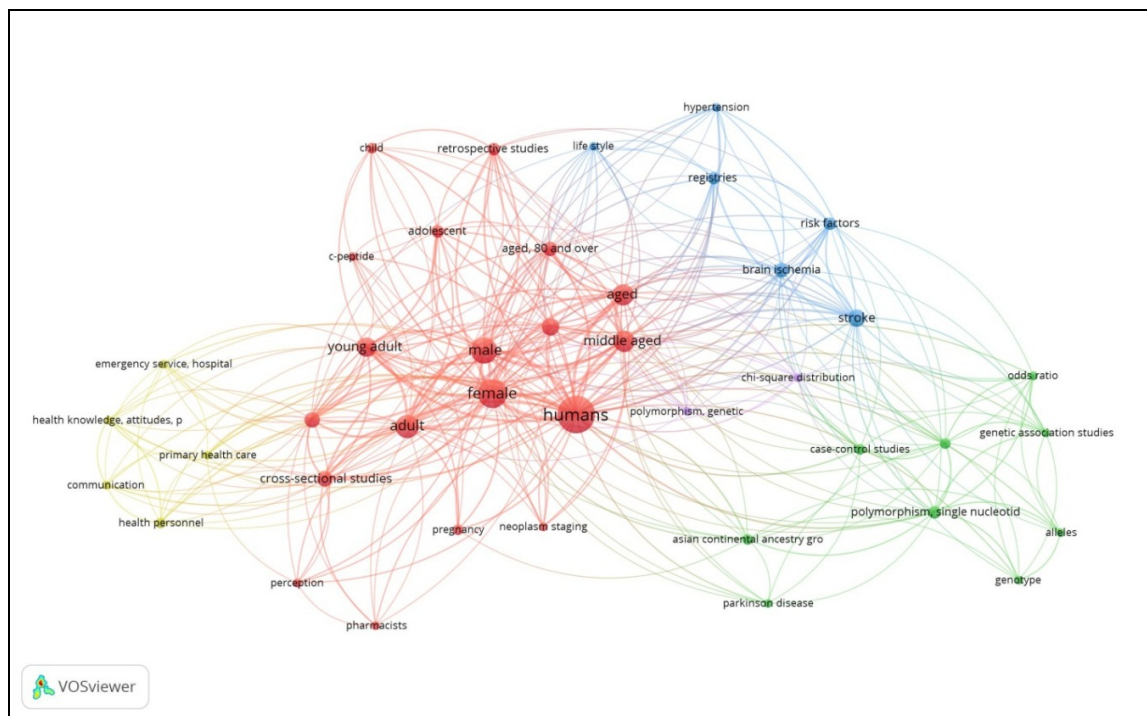


Figure 3. Network visualization map of co-occurrence of MeSH keywords. Keywords with minimum occurrence of two times are shown in the map. Keywords shown with the same colour are closely related and listed together. Size of the nodes and words represent weights; the bigger the nodes and words, the larger the weights. Distance between two nodes reflects the strengths between them; a shorter distance means stronger relations. The line between two keywords means they appeared together; the thicker the line, the higher the co-occurrence.

3.5. Association between Sample Characteristics, Researching Habits and Publication Output

Table 4 shows the association between sample characteristics, researching habits and publication output among clinicians. Senior clinicians had about threefold the odds of young clinicians to have a published paper (OR = 2.8, 95% CI 1.2–6.6, $p = 0.012$). Clinical consultants or specialists had about fourfold the odds of medical officers to have a published paper (OR = 4.2, 95% CI 1.9–9.4, $p < 0.001$). Clinicians who were previously involved in research had about fivefold the odds of those who had never been involved in research to have a published paper (OR = 5.3, 95% CI 2.1–13.5, $p < 0.001$). Similarly, clinicians having used reference citation managers had about fourfold the odds of those not having used such tools to have a published paper (OR = 4.2, 95% CI 1.9–9.4, $p < 0.001$). Clinicians having used statistical software had almost fivefold the odds of those not having used such software to have a published paper (OR = 4.6, 95% CI 1.7–12.5, $p = 0.001$). Clinicians aware of major indexing databases had about threefold the odds of those unaware of such databases to have a published paper (OR = 3.2, 95% CI 1.2–8.6, $p = 0.019$). Clinicians aware of the Belmont Principles and the Helsinki Declaration had almost threefold the odds of those unaware of such ethical principles to have a published paper (OR = 2.6, 95% CI 1.2–5.8, $p = 0.018$).

Table 4. Association between Socio-Demographic Characteristics, Researching Habits and Publication Output ($n = 201$).

Characteristics	Published a Scientific Paper		OR	95% CI	<i>p</i> -Value
	Yes n (%)	No n (%)			
Gender					
Men	16 (20.8)	61 (79.2)	1.5	0.7–3.2	0.250
Women	18 (14.5)	106 (85.5)	1		
Age group (years)					
≤30	16 (17.8)	74 (82.2)	1		
>30	18 (16.2)	93 (83.8)	0.9	0.4–2.0	0.769
Clinician level					
Young clinician	23 (13.9)	143 (86.1)	1		
Senior clinician	11 (31.4)	24 (68.6)	2.8	1.2–6.6	0.012
Current practice					
Medical based	11 (13.4)	71 (86.6)	0.5	0.2–1.4	0.186
Surgical based	13 (17.3)	62 (82.7)	0.7	0.3–1.6	0.473
Others	10 (22.7)	34 (77.3)	1		
Occupation type					
Consultants/Clinician specialists	14 (36.8)	24 (63.2)	4.2	1.9–9.4	<0.001
Medical officer	20 (12.3)	143 (87.7)	1		
Previous involvement in research					
Yes	28 (26.4)	78 (73.6)	5.3	2.1–13.5	<0.001
No	6 (6.3)	89 (93.7)	1		
Ever used reference citation manager like ReadCube/Mendeley/EndNote/Zotero					
Yes	14 (36.8)	24 (63.2)	4.2	1.9–9.4	<0.001
No	20 (12.3)	143 (87.7)	1		
Ever used statistical package like SPSS/STATA					
Yes	29 (23.8)	93 (76.2)	4.6	1.7–12.5	0.001
No	5 (6.3)	74 (93.7)	1		
Aware about major indexing databases like PubMed/Scopus/EBSCO, PsychInfo					
Yes	29 (21.2)	108 (78.8)	3.2	1.2–8.6	0.019
No	5 (7.8)	59 (92.2)	1		
Awareness of Belmont Principles and Helsinki Declaration					
Yes	12 (29.3)	29 (70.7)	2.6	1.2–5.8	0.018
No	22 (13.8)	138 (86.3)	1		

3.6. Association between Journal Selection Attributes and Publication Output

Table 5 exhibits the associations between journal selection attributes and publication output among clinicians. The odds of having published a scientific paper was higher among clinicians who emphasized greater importance on peer reviewed (OR = 2.5, 95% CI 1.1–5.5, $p = 0.015$); open access

(OR = 2.2, 95% CI 0.9–4.9, $p = 0.048$); submission to publication speed metrics (OR = 2.2, 95% CI 1.1–5.0, $p = 0.041$); impact factor (OR = 3.6, 95% CI 1.3–9.8, $p = 0.008$); manuscript acceptance rate (OR = 2.4, 95% CI 1.1–5.5, $p = 0.030$); and international (OR = 2.9, 95% CI 1.1–8.0, $p = 0.030$) journals. These associations were statistically significant.

Table 5. Association between Journal Selection Attributes and Publication Output ($n = 201$).

Characteristics	Published a Scientific Paper		OR	95% CI	<i>p</i> -Value
	Yes n (%)	No n (%)			
Peer reviewed					
Lesser	12 (11.0)	97 (89.0)	1		
Greater	22 (23.9)	70 (76.1)	2.5	1.1–5.5	0.015
Open access					
Lesser	10 (11.1)	80 (88.9)	1		
Greater	24 (21.6)	87 (78.4)	2.2	0.9–4.9	0.048
Submission to publication speed					
Lesser	10 (11.0)	81 (89.0)	1		
Greater	24 (21.8)	86 (78.2)	2.2	1.1–5.0	0.041
Impact factor					
Lesser	5 (7.2)	64 (92.8)	1		
Greater	29 (22.0)	103 (78.0)	3.6	1.3–9.8	0.008
Manuscript acceptance rate					
Lesser	9 (10.3)	78 (89.7)	1		
Greater	25 (21.9)	89 (78.1)	2.4	1.1–5.5	0.030
Journal indexations					
Lesser	18 (15.1)	101 (84.9)	1		
Greater	16 (19.5)	66 (80.5)	1.3	0.6–2.9	0.415
Local journal					
Lesser	14 (14.7)	81 (85.3)	1		
Greater	20 (18.9)	86 (81.1)	1.3	0.6–2.8	0.435
International journal					
Lesser	5 (8.2)	56 (91.8)	1		
Greater	29 (20.7)	111 (79.3)	2.9	1.1–8.0	0.030
Reputable editorial board					
Lesser	10 (14.7)	58 (85.3)	1		
Greater	24 (18.2)	108 (81.8)	1.3	0.6–2.9	0.535

3.7. Factors Associated with Clinicians' Publication Output by Multiple Logistic Regression Analysis

Multiple logistic regression analysis yielded four significant factors associated with clinicians' publication output. The most significant attribute of publication output in the model was clinicians' 'previous involvement in research' (aOR = 4.2, 95% CI 1.5–11.4, $p = 0.004$); followed by 'consultants or specialists' (aOR = 2.5, 95% CI 1.1–10.0, $p = 0.023$); clinicians who had 'ever used reference citation managers like ReadCube/Mendeley/EndNote/Zotero' (aOR = 3.2, 95% CI 1.3–7.7, $p = 0.010$); and clinicians who emphasize journal selection metrics' 'submission to publication speed' (aOR = 2.9, 95% CI 1.2–7.1, $p = 0.019$). The total model was significant ($p < 0.001$) and accounted for 34% of the variance. There was no multi-collinearity between independent variables (Table 6).

Table 6. Factors Associated with Clinicians Publication Output using Multiple Logistic Regression (Backward Wald) ($n = 201$).

Characteristics	B	SE	Wald	Exp (B)	95% CI	p-Value
Occupation type						
Consultants/Clinician specialists	1.1	0.4	5.2	2.5	1.1–10.0	0.023
Medical officer	Ref	Ref	Ref	Ref	Ref	Ref
Previous involvement in research						
Yes	1.4	0.5	8.3	4.2	1.5–11.4	0.004
No	Ref	Ref	Ref	Ref	Ref	Ref
Ever used reference citation manager like ReadCube/Mendeley/EndNote/Zotero						
Yes	1.1	0.4	6.6	3.2	1.3–7.7	0.010
No	Ref	Ref	Ref	Ref	Ref	Ref
Submission to publication speed						
Lesser	Ref	Ref	Ref	Ref	Ref	Ref
Greater	1.1	0.4	5.5	2.9	1.2–7.1	0.019

Note: Variables entered include all significant variables in the bivariate analysis; Exp(B) gives the adjusted Odds Ratio (aOR); “Ref” indicates reference category.

4. Discussion

4.1. Findings, Consistencies and Plausibilities from Self-Report Survey

This study aimed to determine the factors associated with publication output among clinicians in a Malaysian research hospital. Of the 201 clinicians surveyed, 16.9% reported that they had published a scientific paper throughout their clinical practice. The estimated self-reported publication rate reported in this study was lower than that found in Colombian medical students (22%) [20], Japanese urologists (24.6%) [21] and resident surgeons from Canada (57.8%) [24], but relatively higher than that found among resident physicians with no research electives in the USA (5%) [25] and Pakistan (7.5%) [9]. Duclos et al. [26] argued that clinicians had poor capacity to contribute to scholarly literature due to the limitation of time to undertake the medical writing and publishing process; lack of incentives; and lack of interest in research. In contrast, higher publication volume reported in other settings could be attributed to variations in sample size, exposures to research electives during clinical practice or different methodologies used, such as bibliometric and scientometric analyses, which have been regarded as the “gold standard measure” of scientific productivity among the countries regarded as “science powerhouses” [4]. The relatively higher publication output amongst medical students found in the previous literature [20] could be attributed to the fact that medical students were still being affiliated within the medical academic institutions, thus escalating their chances of being involved in research and scientific publication activities with their supervisors or academic professors. To our knowledge, this is the first study that attempted to explore publication output among clinicians from two perspectives; using the self-report measure and descriptive bibliometric analyses. The approach may have limited our ability to justify consistencies using different epidemiological data from other settings in Asia or the European sub-continent. In the final logistic regression model from the self-report survey, occupation type, previous involvement in research, usage of reference citation managers and journal metrics evaluating the submission to publication speed were significantly associated with clinicians’ publication output.

Gender and age were the two important socio-demographics that were previously hypothesized to influence clinician-scientist publication output, yet they showed no statistical significance in the current study [27,28]. The first was the influence of gender on publication output. Literature has highlighted that women were less represented in scholarly scientific output despite that their proportion of being engaged in clinical medicine is fast approaching that of men [27,28]. Similar consistencies were observed in the current study, but the relatively higher odds of having a published paper among men than women showed no statistical significance.

With regards to age, the bulk of literature highlighted that the tendency to have a paper published increased with age, reaching a peak or maturation phase during the career and then declining gradually after the age of 50 [20,21,26,29,30]. In this study, while we found that clinicians aged more than 30 years old have higher odds of having a paper published, this association was not statistically significant. Interestingly, our findings found that “occupational age” measured as “clinician’s level” in this study had a significant association with publication output. Senior clinicians had almost threefold the odds of having a published paper in comparison to young clinicians. This association was inconsistent with previous studies from Japan [21] and the USA [31]. These two studies were specifically focused on urology trainees that had a paper published during their residencies or postgraduate trainings. The studies predicted that the urologist capacity to have more papers published will escalate over time as seniority increases. The plausibility of the fact that senior clinicians are more productive than younger ones could be attributed to Merton’s theory of cumulative advantage [32,33] and the “Matthew effect” [32]. These concepts postulated that younger clinician-scientists may gain more scientific capital, allowing greater access to resources to be scientifically productive. In contrast, senior clinician-scientists are more likely to be leaders of research teams, hence able to intellectually sign high volume of papers. This could be observed when junior clinicians or residents are supervised by senior clinicians within their subject matter clinical expertise to execute research projects and reporting of study findings, a phenomenon similarly observed within the academic-student relationships during postgraduate studies at tertiary institutions. This scientific maturity of work-flow is prevalent when senior clinician-scientists produced fewer first-authored papers than younger clinician-scientists while having their names as last co-authors [34].

In this study, we found that clinical specialists and consultants were more likely to have a published paper in comparison to medical officers. A plausible explanation of such phenomenon to occur is the engagement of clinical specialists or consultants as principal investigators in clinical trials or related research in accordance to their subject matter expertise. Research has propelled itself as a role expectation for clinician specialists and the output generated is perceived to be highly beneficial for the advancement of patient care, in addition to the acceleration of clinicians’ professional development and peer recognition in medical practice [35]. Coherently, this study found that clinicians being previously involved in research were more likely to have a published paper and this association was statistically significant. Similar findings were observed in a Colombian medical student researcher cohort [20]. It could be postulated that any previous involvement in research increases the likelihood to have a completed project, thus escalating the chances to have a published paper for dissemination of scientific findings within the scholarly literature.

The value of scientific output depends on the validity and reliability of the hypotheses generated or tested through rigorous research methodologies [36]. The output confirmed should be critically crafted as a device document for production with reliable and valid justifications to apprehend its consistencies, plausibility, temporality, specificity, analogy and coherence from available references or citations in the scholarly literature [37]. Such authorships role is indeed tedious in manuscript writing and preparation for publication in a journal. A novel finding in this study is the significant associations between the applications of reference citation managers like ReadCube, Mendeley, EndNote, or Zotero with clinicians’ publication output. Authors often face hurdles in referencing a scientific paper due to the diverse categories of citable data sources and formatting styles. The large numbers of different data fields like books, patents, guidelines, encyclopedia, research articles, editorials, blogs, websites or grey literature for each citable material often require different formatting styles [38]. These predispose authors to face erroneous or incomplete citations, possible typos and errors in punctuation or text formatting for abbreviating authors’ names or journal titles and listing of references in order with appropriate in-text citations. These requirements often pose substantial challenges for authors to ensure correct referencing format while preparing a manuscript for publication. The increasing availability of reference citation manager tools has allowed authors to overcome these barriers using customizable

and user friendly interface in preparation of references according to the journal requirements in a timely manner [38].

Medical publishing underwent a massive transformation with the emergence of open access publishing since the Berlin 12 Conference in 2003 [39]. The Berlin conference marked the declaration of championing open access publishing models to make scientific knowledge freely available. It was a point to transform traditional subscription-based publishing system to make articles freely open without restrictions to readers and the scientific community. The OA2020, a transformative agenda to accelerate newer approaches of publishing system was catalyzed, with the crafting of newer standard policies to which authors' payments and cash flow to the journals were organized. The publishing and financial models were intended to be unified in such a way so that the switch would be feasible to be executed across the scientific community [39]. Many journals championed aggressive peer review, emphasizing high quality impact and indexations while embracing open science practices with shorter production times in the fast moving research areas in medicine [40]. At the bivariate level, this study found that preferences on peer reviewed, open access, impact factored, speed, manuscript acceptance rate and international journals were key selection attributes that significantly influence clinicians' scientific output. These associations were consistent with previous studies [9,40,41]. However, at the multivariate level, publication speed was the only journal metric attribute that was significantly associated with clinicians' publication output. The dictum "medicine is a science of uncertainty and an art of probability" as mused by Osler [42] may have triggered clinicians in the current evidence-based era to avail themselves of or share relevant information and discoveries related to clinical practice immediately through scholarly science publishing for advancement of patient care.

4.2. Findings from Bibliometric Analysis

Our findings showed that most clinicians published original research articles (76.4%). This could be attributed to clinicians' anticipation to produce new evidence for practice through research involving patients based on their clinical specialties. Keywords analysis showed 41 common items grouped into five main clusters, which amounted to a total of 238 occurrences. In the first cluster, we observed that most papers published in our institution (either as first author or co-author) were observational studies involving human subjects across paediatrics, obstetrics and gynaecology or other specialties involving both adult men and women. Subjects in this cluster of published papers varied across diverse age groups, children, adolescents, pregnant mothers, young-, middle- and old-aged adults. The second cluster emphasized genetic studies. This could be attributed to our centre's commitment and collaborations to nearby academic institutions and laboratories to execute genetic studies, in particular towards neurology and geriatric sub-fields, as being one of our centre's core services. The third cluster was directed towards stroke research. Our hospital, the main neurology centre for the state of Penang in Northern Malaysia, handles the official stroke registry. It will be anticipated that most publications from this cluster were based on registry data. The fourth cluster suggests papers that address health services and systems research. This could be observed based on relevant keywords involving health personnel during acute, follow-up and rehabilitation services that involve communication and health education in emergency and primary care settings. The fifth cluster could be observed as an overlap cluster with other clusters, particularly in relation to genetic studies in view of the usage of chi-square distribution. This statistical analysis in observational studies yields odds ratios for case-control studies that could be employed to find genetic associations. A pooled data observation analysis of odds ratios is another possibility through meta-analysis papers.

The evolving field of medicine and revolution of disease epidemiology has forced clinicians and healthcare workers to have wider collaborative scientific social networks for knowledge sharing. Co-authorship analysis is important for determining the social structure of the field being studied and how it relates to collaboration between authors and their affiliations [43]. It is the most tangible approach and contains well documented forms to explore scientific collaborations in terms of illustrating research teams, factors influencing co-authorships and impact-output metrics [44]. This study found that a

total of 308 authors from 28 different collaborated clusters published 55 scientific papers from the co-authorship analysis. It would be wise to appreciate that this finding, which was consistent with a previous study within the medical field [45], has placed great importance on co-authorships collaborative efforts as fundamental to enhancing research output quantity and quality across boundaries (regional, national, international or interdisciplinary boundaries) in the quest to yield new knowledge, innovations and discoveries in healthcare [45,46].

The relatively low amount of publication output among the large number of clinicians in our study sample had somewhat distorted the frequency distribution of the scientific productivity curve as proposed by Lotka's Law [47]. Lotka's Law indicates an inverse relationship between the number of publications and the number of authors producing those publications. For all authors in a given field, the rule proposed that 60 percent of authors will have at least one publication, 15 percent will have at least two publications, 7 percent will have at least three publications and about 6 percent will have 10 publications. Our output generated far less than the output suggested by this law. Similar consistency was observed in a previous study [45]. However, emerging literature has challenged this postulation on the applicability of Lotka's Law to other fields, especially within the biomedical field [45]. The relatively low number of publications among healthcare workers, for example, clinicians in our sample, could be attributed to a number of factors influencing scientific productivity. These may include clinicians migrating or being posted to other hospitals or healthcare facilities, thus changing affiliations overtime. In addition, clinical practice is time-constrained and clinicians have limited dedicated time to be involved in medical publishing due to their commitment in patient care. Another limitation is that Lotka's study focused specifically on first authors, hence medical related studies that require collaborative teams from different disciplines may deviate from Lotka's assertions [45,46,48].

4.3. Study Limitations

The relatively small sample size of our study population may have increased the possibility of type II error in our results. For example, the "open access" journal metric attribute may have achieved better statistical significance in association with clinicians' publication output ($p = 0.048$). The use of self-report measures to determine scientific productivity may have led to the rise of response bias. However our cohort offered advantages to offset this limitation through bibliometric analysis using a PubMed database. The cross-sectional nature of this study could not establish temporality between independent variables. Extrapolation of the study findings to a nationally representative population of clinician-scientists was not possible given the limitation of the study findings conducted from a single hospital in Northern Malaysia. Despite these limitations, the findings found from this preliminary investigation may form a platform for future testable hypotheses using robust methodological techniques, given that Malaysia's recent declaration as one of the "Big 5" emerging scientific productivity powerhouse in East Asia [4]. Further investigations using national bibliometric or spatial scientometrics through additional databases analyses like Scopus, EBSCO or PsychInfo could be executed to explore the missed number of publications, types of study designs published, collaborations and citation indices obtained by the authors. Such analyses could also facilitate better understanding of unanswered research questions, like the influence of gender, age, specialties or geographical patterns within the country towards clinicians' scientific productivity in Malaysia.

5. Conclusions

We found that socio-demographics (occupation type), researching habits (previous involvement in research and the use of reference citation manager) and journal metrics (publication speed) were all significantly associated with publication output among clinicians in our centre. Real outputs from bibliometrics were predominantly focused across five clusters. Our sample was not comprised of "academic clinicians" solely (clinicians whose practice would involve academic teaching, curricular development or scholarly activities in a university teaching hospital). Instead, they were hospital based clinicians whose primary practice is evidence based medicine, and hence are unlikely to be

routinely engaged in scholarly activities. However, these clinicians are granted protected time during their clinical practice by the Ministry of Health Malaysia to catalyze research and publication activities for the advancement of patient care. As such, these clinicians may not aptly appraise scientific publication processes and metrics as compared to academic clinicians. In line with the nation's rigorous advancement of scientific publication volume, these findings enhance our knowledge on potential factors influencing clinicians' choice to publish their scientific work within the scholarly literature.

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