

## BIO-BIBLIOMETRIC ANALYSIS OF DR. LEE HAN LIM – THE PROMINENT MEDICAL ENTOMOLOGIST, MALAYSIA

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### ABSTRACT

This paper presents a bio-bibliometric analysis of Dr. Lee Han Lim's scientific contributions to medical entomology, particularly vector-borne diseases such as dengue, malaria, Zika, and chikungunya, medical forensics, and maggot therapy. The analysis, through his scientific article, technical reports, and presentation, includes the geographical and year-wise distribution of publications, collaboration for publication, publications by type, journal preferences for publication, and citation of the scientific articles. The study indicated that Dr. Lee is a prolific writer in Medical Entomology. Throughout his career and available records until 31<sup>st</sup> December 2021, he has contributed 998 scientific items, including 338 articles, 502 presentations and 158 technical papers and guidelines. Research work conducted by Dr. Lee has been well accepted in developed (e.g. the United Kingdom) and developing (e.g. Thailand) countries. Approximately ninety per cent of his research work was the outcome of collaboration. His publication is of good quality, and 1,963 documents have cited his works, contributing to a high H-index of 27 to recognise his excellent works.

**KEYWORDS:** Bibliometrics, Bio-bibliometrics, Lee Han Lim, H-Index, Medical Entomology

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## INTRODUCTION

Bio-bibliometric is a branch of the bibliometric discipline. It uses a quantitative approach of applying mathematical and statistical techniques to count for various parameters of a writer's articles, books and other publications (Pritchard 1969; Ball 2017). This approach can be applied to any discipline to determine the tendency and productivity of the targeted literature. While the bibliometric study can be applied to define general productivity in a given area, it may also be used to evaluate the productivity of individual researchers, journals, countries or other performance levels (Andrés 2009; Todeschini and Baccini 2016). More importantly, a bibliometric analysis of scholars and prolific writers could play an essential role in motivating and attracting young professionals towards scientific writing and the communication of knowledge.

Various bio-bibliometric studies have been conducted internationally. For example, the analysis on Professor Kanwal found that he has produced 137 research items, including 81 articles, 34 conference papers, 15 book chapters, four books and three book reviews during his research career of 27 years, covering from 1991 to December 2017 (Haq and Ahmad 2019). Another study on Prof. B. N. Koley, Koley & Sen (2006) found that he had published 251 publications and worked with 86 collaborators from India, the United States of America (USA), the United Kingdom (UK), Germany and Britain between 1958-2001.

In comparison, in Malaysia, only two bio-bibliometric studies are being conducted. Tiew (1999) conducted bio-bibliometric research on Professor Dato Khoo Kay Kim of Malaysian History at the University of Malaya, Kuala Lumpur. In addition, Lim et al. (2022) have also conducted a bibliometric analysis on the late Dr Lim Boo Liat. Lim et al. (2002) reported that Dr Lim had produced more than 314 articles published in 68 local journals. However, as the oldest research institution in Malaysia, the Institute for Medical Research (IMR) has produced many prominent researchers; among them is Dr. Lee Han Lim, a renowned medical entomologist in Malaysia who is recognised internationally. Therefore, this research aimed to describe and analyse the literature of Dr. Lee Han Lim produced throughout his decade-long tenure at IMR. The research questions, i.e., what were the number of publications? What were the patterns and networking of authorship? How were the collaboration coefficient and journal-wise distribution? How was the keyword analysis? What was the impact of the journal on citations?

### Biodata of Dr. Lee Han Lim

Dr. Lee Han Lim is one of the renowned medical entomologists in Malaysia and the Southeast Asian region. He was born in Kuala Kangsar, Perak. He graduated with a Bachelor's degree from Universiti Sains (USM) Malaysia in Biology (Entomology & Parasitology) before completing his Diploma in Applied Parasitology and Entomology (SEAMEO) in 1978. In 1996, he completed his postgraduate studies at USM with a Master of Science (Medical Entomology) before obtaining his Doctor of Philosophy (PhD) in the same field in 1999.

He started his career in IMR as a researcher in 1978. Next, he became the Head of the Unit on 6 March 1993. Also, he served as the Head of the World Health Organisation (WHO) Collaborating Center for Ecology, Taxonomy and Control of Vectors of Malaria, Filariasis & Dengue, the Dean of the School of Diploma in Applied Parasitology and Entomology (2004-2011) as well as the 33rd president of the Malaysian Society of Parasitology & Tropical Medicine (MSPTM) (1996/1997). He retired in 2011 and was reemployed under contract from 2011 to 28 February 2018 due to his excellence and expertise in Medical Entomology research.

During his tenure, he won various awards. IMR also awarded him the Best Young Scientist Award for two consecutive years, in 1990 and 1991. In 1993, he won the Third World Best Young Scientist Award. In terms of innovation, he has won more than ten awards in innovation competitions at the national or international level. These recognitions include the National Innovation Award six times, Gold Award at the International Invention, Innovation and Products 2002 (Geneva, Switzerland and S&T Exhibition) and 25th Anniversary of Ministry of Science, Technology & SEAMEO Service Award in 2007 (Bali, Indonesia), National Institutes of Health (NIH) Best Researcher Award in 2010, Sandosham Gold Medal Award of the MSPTM in 2014, Ungku Omar Award, NIH Malaysia 2014, Dr. Lee Jong-wook Memorial Prize for Public Health of the WHO in 2018.

Furthermore, he has also received a total of 64 research grants throughout his career. As a researcher at IMR, starting with a grant from IMR at the beginning of his career, he then received various research grants at the international level, such as from WHO-Japan, Wellcome Trust and so on.

Dr. Lee has also supervised postgraduate students at the Master's and PhD levels. In addition, he supervised students

at the postgraduate diploma level in medical entomology, of whom he was the main supervisor of 11 students and co-supervisor of 22 students.

## **MATERIALS AND METHODS**

We employed primary and secondary data collection in this study. We conducted the interview and obtained the curriculum vitae from Dr. Lee. We searched the Google Scholar, Scopus and ResearchGate databases using the Lee HL, Lim HL, L Han Lim, Lee Han Lim, L Han Lim, and LH Lim. For each result from the three search databases, we checked the affiliation of each paper to ensure the author's address was stated as IMR. Dr. Lee has been working in IMR throughout his career. In addition, we also verified using Dr. Lee's ORCID and Scopus ID to ensure every paper was noticed.

In addition, we searched for hard-copy articles at the NIH Library, Ministry of Health Malaysia, and the book or journal repository at the Biomedical Museum Unit, IMR, Annual Report from 1978 to 2020 during his service in IMR. We included all scientific articles, technical reports, proceedings and presentations in the analysis. Two members of the research team checked the titles of the data obtained to validate the writings of Dr. Lee Han Lim. Only the data or list of journals agreed upon by the two researchers were entered into the database.

Upon data entry into databases, the data were re-evaluated with a more in-depth search, i.e. by further searching the article's title online or hard-copy at the NIH Library and the Biomedical Museum Unit to ensure the accuracy of the data. All data obtained were finally entered into the Microsoft Excel database for technical reports, proceedings, and presentations. The frequency was analysed for presentation and technical by year and duration of service. We conducted a more detailed analysis of the scientific journal: year of publication, country of publication, volume, pages, number of author (s), and Dr. Lee's position in the author list.

The h-index is defined as the maximum value of h such that the given author/journal has published at least h papers that have each been cited at least h times (McDonald 2005; Hirsch 2005). The m-index is defined as  $h/n$ , where h is the h-index and n is the number of years since the scientist's first published paper; it is also called the m-quotient (Hirsch 2005; Bohlen Und Halbach 2011).

Data on Dr. Lee's h Index and the ten most cited articles were obtained from Scopus electronic databases. We cleaned the data. In addition, we standardised the list of author(s) and article topics in the database. This data cleaning was essential to network between authors and ensure keywords can be detected in further analysis using VOS viewer software. We exported the cleaned data to Statistical Package for the Social Sciences (SPSS) software, and descriptive statistics were applied to describe the number of publications, the number of authors, the year of publication, the name of the journal, and the first author and co-author. At the same time, the networking analysis among authors and keywords based on the title was conducted using VOSviewer software.

## **RESULTS**

### **Number of publications, presentations, guidelines, technical reports and thesis**

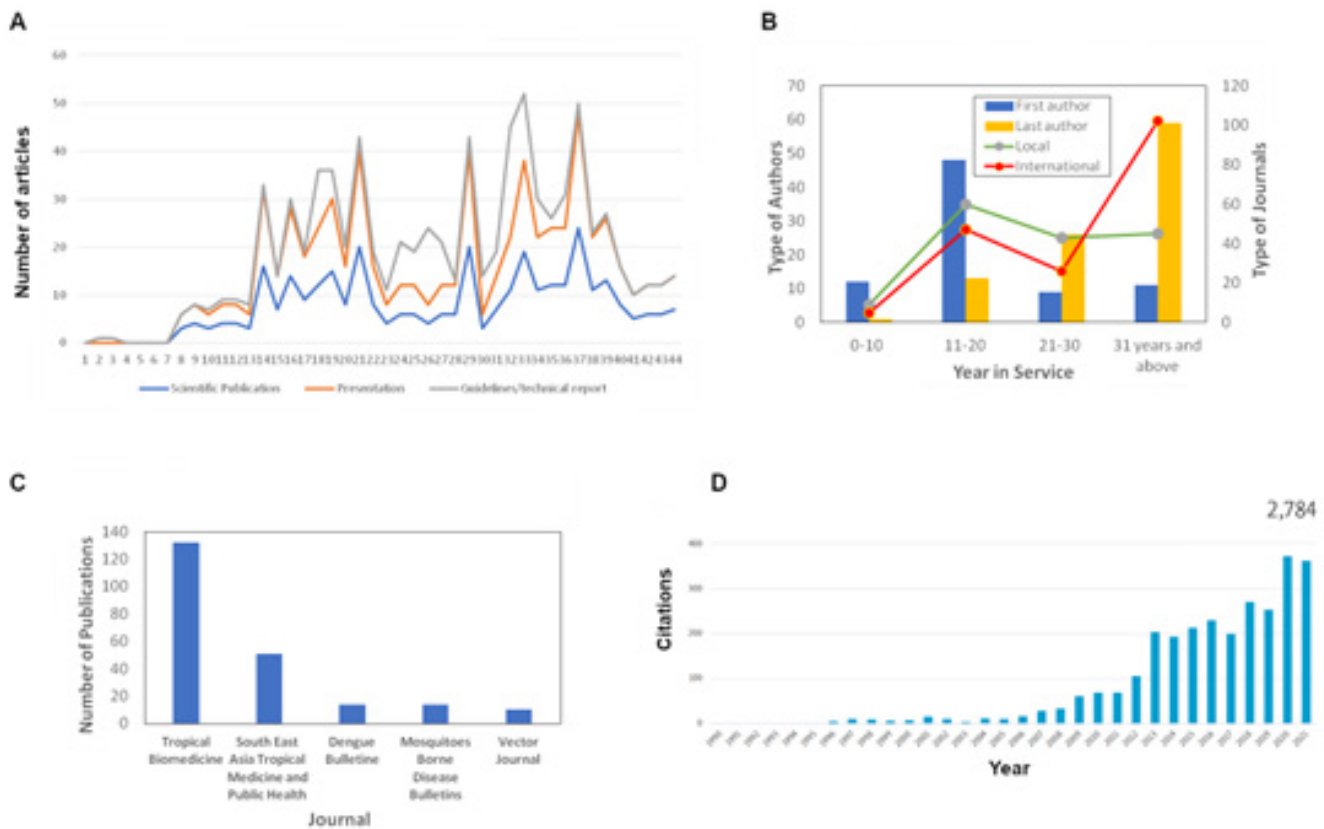
From 1978 to 2020, Dr. Lee published 338 scientific publications, a mean of 7.86 articles per year. He has also presented 502 research findings at local and international conferences. Of his 43 years of service, Dr. Lee published 158 technical reports/guidelines/theses (Table 1).

Fig. 1A, 1B and 1C show the number of publications, presentations and technical reports by Dr. Lee according to the length of service, where the data reported that more than three fourth of presentations (77.9%) and technical reports (77.2%) were published after 21 years in service. In comparison, 32.0% of the scientific articles were published during 11-20 years of service, and 63.6 % (n=215) were published for a period after 21 years of service. Fig. 1A shows a similar publication trend for scientific papers, presentations and guidelines/technical reports except for 23-27 years of service, where the publication of technical reports/guidelines increased while there was a trend of decreased presentations and scientific articles.

**Table 1.** Number of scientific articles, presentations and technical reports/guidelines of Dr. Lee

Year	Scientific article	Presentation		Technical report/ guidelines	Age	Service in IMR
		Local	International			
1977	0	0	0	0	24	0
1978	0	0	0	1	25	1
1979	0	0	0	1	26	2
1980	0	0	0	0	27	3
1981	0	0	0	0	28	4
1982	0	0	1	0	29	5
1983	0	3	0	0	30	6
1984	3	1	0	0	31	7
1985	4	2	0	0	32	8
1986	3	2	0	1	33	9
1987	4	2	0	1	34	10
1988	4	2	0	1	35	11
1988	3	5	0	2	36	12
1989	16	7	0	1	37	13
1990	7	3	0	0	38	14
1991	14	12	0	2	39	15
1992	9	16	0	1	40	16
1993	12	14	10	12	41	17
1994	15	10	1	6	42	18
1995	8	14	1	4	43	19
1996	20	5	0	3	44	20
1997	8	14	1	3	45	21
1998	4	26	1	3	46	22
1999	6	20	2	9	47	23
2000	6	9	2	7	48	24
2001	4	8	6	16	49	25
2002	6	6	2	9	50	26
2003	6	6	6	1	51	27
2004	20	8	5	3	52	28
2006	3	19	5	8	53	29
2007	7	12	4	5	54	30
2008	11	18	5	23	55	31
2009	19	31	12	14	56	32
2010	11	24	4	8	57	33
2011	12	23	1	2	58	34
2012	12	46	1	7	59	35
2013	24	23	1	2	60	36
2014	11	8	2	1	61	37
2015	13	24	0	1	62	38

2016	8	1	1	0	63	39
2017	5	1	2	0	64	40
2018	6	0	1	0	65	41
2019	6	0	0	0	66	42
2020	7	0	0	0	67	43
Total	338	425	77	158		



**Figure 1.** (A) Number of publications (scientific publication, presentation, guidelines/technical report by year of service; (B) Geographical, journal-wise distribution and collaboration coefficient by year of service; (C) The top five journal preferences of Dr. Lee; (D) Number of documents cited Dr. Lee scientific articles by year

**Scientific article: pattern of authorship**

Of the 338 articles published by Dr. Lee, approximately one in ten (n=37, 10.9%) of them were written by him as the only author, while the remaining publications have multiple authors (n=300, 88.8%). Of the 37 publications as solo authors, more than 90 per cent (n=35) of them were produced during 11-20 years of service. Among 300 scientific articles with multiple-author papers, he was the first author for 80 of the publications (26.7%), while for the rest of the publications, he was a co-author. A total of 81 scientific publications (24.0%) were published during the 21-30 and 31 years of service period (Table 1 and Fig. 1A)

**Geographical aspects of journal publications (local or international), collaboration coefficient and journal-wise distribution**

Dr. Lee published his scientific articles in 72 journals, both locally and internationally. Notably, more than half of Dr. Lee's scientific publications (n=180, 53.3%) were published in international journals. Out of 180 journals published internationally, almost 20% of South East Asia Tropical Medicine and Public Health and Mosquito-Borne Disease Bulletin were published in Thailand, while 10.2% were in Switzerland. Analysis based on his service in IMR, the period of 31

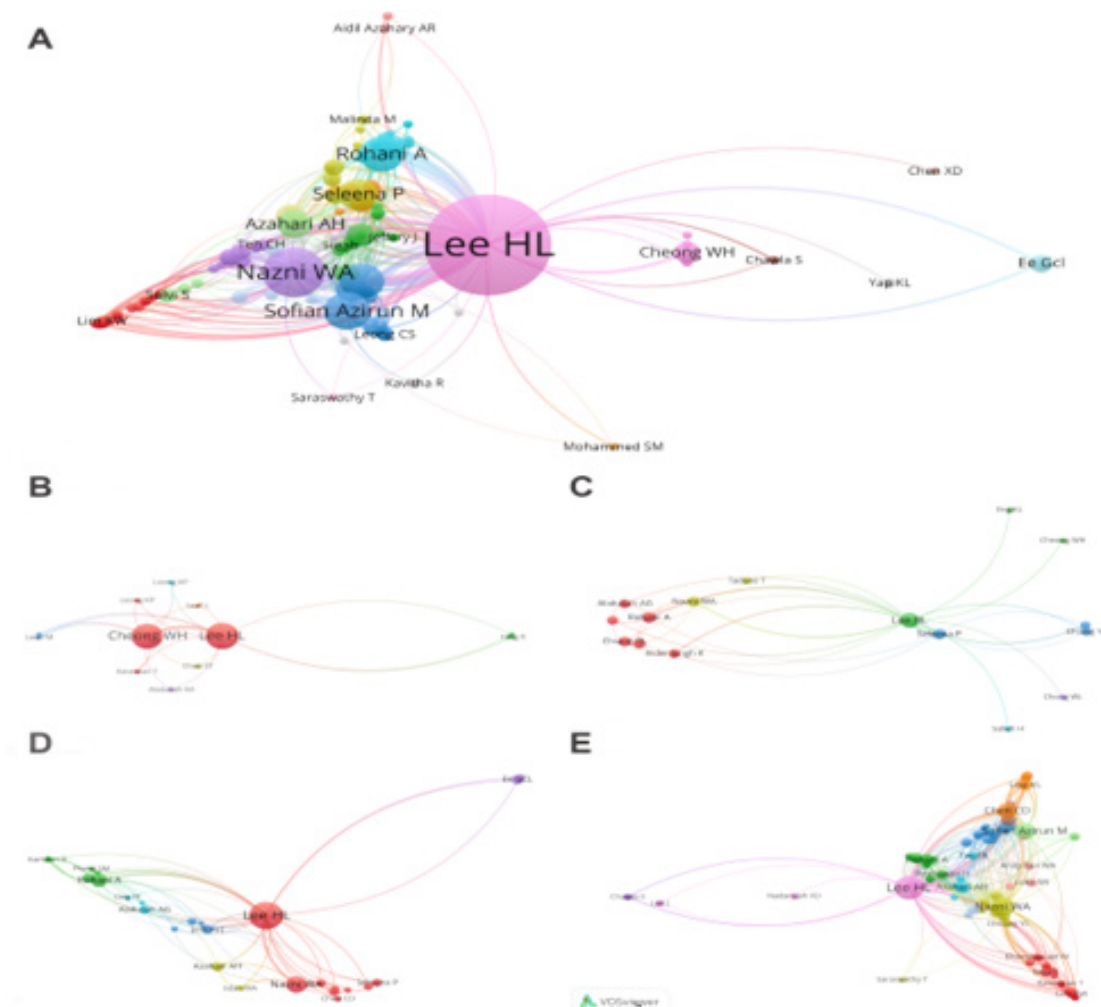
years and above was the period where he recorded the most international publications ( $n=102/180$ , 56.7%), whilst more than one-third of scientific articles (38.3%) were published locally during the service of 11-20 years (Fig 1B).

The overall collaboration coefficient (CC) of Dr. Lee, which was calculated based on the formula suggested by Ajiferuke et al. (1988), found an overall CC of 0.75; it was highest after 31 years in service (0.82) and the lowest during 11-20 years in his service in IMR (0.40). The CC value of 0.75 indicated that Dr. Lee had actively collaborated with the other researchers in the field (Fig 1B).

The analysis also found that almost two-thirds of his scientific articles (66.0 %) were published in three major journals, namely Tropical Biomedicine ( $n=132$ , 39.1%), South East Asia Tropical Medicine and Public Health ( $n=51$ , 15.1%), Dengue Bulletin ( $n=14$ , 4.1%) (Fig 1C).

### Networking of authorship

Fig 2a-2e showed a network of collaboration in the writing of scientific articles by Dr. Lee. The top 5 co-authors are Nazni Wasi (82 articles), Sofian Azirun (45 articles), and Rohani A (41 articles). Analysis based on service in the year showed that during the service period of 0-10 years, Cheong WH was the most dominant co-author, while during the service period of 11-20 years, Selena P was the most dominant co-author of Dr. Lee. In 21-30 years, Nazni Wasi and Rohani A were the lead co-authors (Fig 2a-2e).

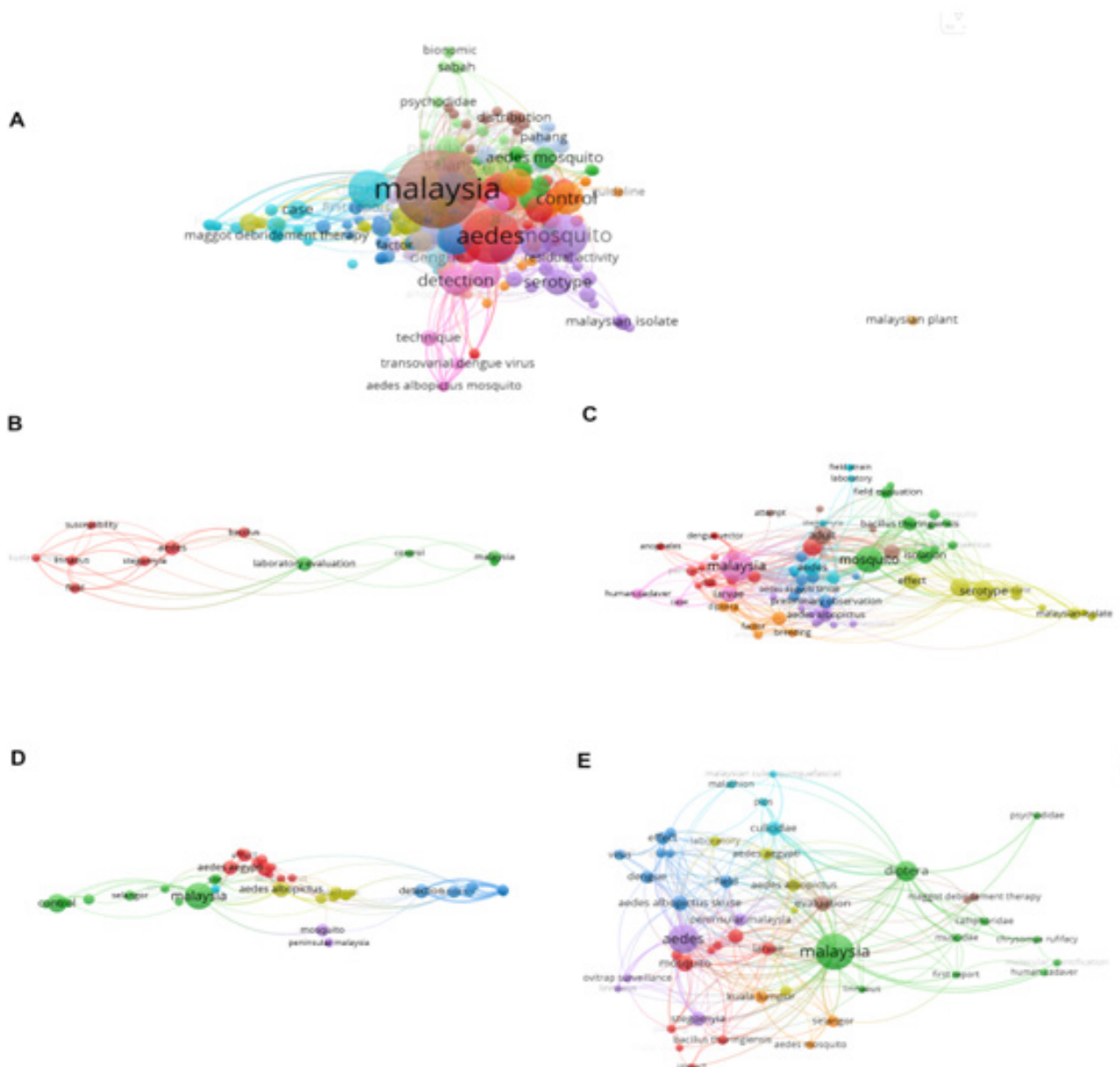


**Figure 2.** (A) Overall author networking of Dr. Lee; (B) Author networking of Dr. Lee during 0-10 years in service; (C) Author networking of Dr. Lee during 11-20 years in service; (D) Author networking of Dr. Lee during 21-30 years in service; (E) Author networking of Dr. Lee after 31 years in service.



**Keyword analysis**

The keyword analysis showed that most of Dr. Lee's publications resulted from research conducted in Malaysia. The overall focus of his publications is related to Malaysia (106 occurrences in the title), *Aedes* (52), mosquito (34), Diptera (27), *Aedes albopictus* (20), control (19), *Bacillus* (17), *Culex quinquefasciatus* (17) (Fig 3A). Analysis by year of service found that many keywords were during his service period of 11-20 years and 31 years and above (Fig 3B-E); this was positively correlated with the number of publications. In the early period of his service, the keywords "laboratory evaluation" and "*Aedes*" were among the dominant. After ten years, Dr. Lee's publications revolved around *Aedes* mosquitoes in the field, in addition to his diversity in research on *Aedes* mosquito vectors (serotype, isolation, larvae, control, *Bacillus thuringiensis* (*Bti*), malathion). While the study on the control of *Aedes albopictus*, *Aedes aegypti* and *Culex quinquefasciatus* focuses on insecticide susceptibility, "malathion", "permethrin" are the keywords of his publication in the service period of 21-30 years. Keyword analysis indicated diversification after 31 years of his service, which keywords during this period almost resembled his publication keywords during his tenure of 11-20 years with additions such as "maggot debridement".



**Figure 3.** (A) Overall analysis of keywords of scientific articles of Dr. Lee Han Lim; (B) Keywords of Dr. Lee Scientific articles during the duration of 0-10 years in service; (C) Keywords of Dr. Lee Scientific articles during the duration of 11-20 years in service; (D) Keywords of Dr. Lee scientific articles during 21-30 years in service; (E) Keywords of Dr. Lee Scientific articles after 31 years in service

### Citation of the scientific articles

A search in the Scopus database found only 188 scientific articles by Dr. Lee from the period of 1984-2020. Of the 188 scientific articles, they were cited by 2,784 reference scientific articles from 1,972 journals. Among these scientific articles, 177 were mentioned by at least one scientific article (94.1%). The citation increased linearly from 2006 to 2021, the highest was in 2020. Dr. Lee's citation index was 27.

The scientific article that has the most citations was the article "Open Field Release of Genetically Engineered Sterile Male *Aedes aegypti* in Malaysia", which was cited by 154 scientific articles. It was followed by the scientific article "Establishment of *Wolbachia* Strain wAlbB in Malaysian Populations of *Aedes aegypti* for Dengue Control", which was cited by 86 scientific articles (Table 2).

**Table 2.** Top ten citations of Dr. Lee's scientific articles by other researchers

No	Topic	Journal	Journal impact factor (Web of Science)	Citation
1	Open Field Release of Genetically Engineered Sterile Male <i>Aedes aegypti</i> in Malaysia	PLOS One	2.9	154
2	Establishment of <i>Wolbachia</i> Strain wAlbB in Malaysian Populations of <i>Aedes aegypti</i> for Dengue Control	Current Biology	8.1	86
3	A neurotoxin that specifically targets <i>Anopheles</i> mosquitoes	Nature Communication	14.7	71
4	Insecticide susceptibility status and resistance mechanism of <i>Anopheles cracens</i> Sallum and Peyton and <i>Anopheles maculatus</i> Theobald (Family: Culicidae) from knowlesi malaria-endemic areas in Peninsular Malaysia	Asian Pacific Journal of Tropical Medicine	1.9	54
5	A preliminary proteomic study of permethrin-resistant and susceptible <i>Aedes aegypti</i> (l.)	Tropical Biomedicine	0.8	54
6	Modelling the Effect of a Novel Autodissemination Trap on the Spread of Dengue in Shah Alam and Malaysia	Computational and Mathematical Methods in Medicine	NA	53
7	Modelling The Effect of a Novel Auto-Dissemination Trap on The Spread Of Dengue In High-Rise Condominia, Malaysia	Journal of Biological Systems	1.3	52
8	Ovitrap Surveillance of <i>Aedes aegypti</i> and <i>Aedes albopictus</i> In dengue Endemic Areas in Keramat and Shah Alam, Selangor in 2016	International Medical Journal Malaysia	NA	51
9	Susceptibility status and resistance mechanisms in permethrin-selected, laboratory susceptible and field-collected <i>Aedes aegypti</i> from Malaysia	Insects	2.7	50
10	Bioefficacy of insect growth regulators against <i>Aedes albopictus</i> (Diptera: Culicidae) from Sarawak, Malaysia: A statewide survey	Journal of Economic Entomology	2.2	49



## Comparison of Dr. Lee Han Lim's publication with the peer

We used the number of scientific papers related to research on "*Aedes aegypti*" from Scopus on 24 April 2024 to compare Dr. Lee's achievements as a proxy for comparison with the peers in the global rankings assessment of the results of the publication of Dr. Lee's scientific articles. We use the number of scientific article publications, h-Index, and m-Index in this comparison. The study results found that Dr. Lee was among the top 10 authors who published articles related to *Aedes* globally and was the only researcher from the Asian continent (Supplementary Table 1). He was in ninth place regarding the number of scientific articles and H-Index, while he was in eighth place in the m-index.

## DISCUSSION

The study shows that Dr. Lee is an excellent researcher from IMR who has published extensively. His findings have been used by policymakers and other researchers in the medical entomological field. In addition, he guides postgraduate students and translates his findings into products used in vector-borne control diseases.

In terms of the publication of scientific articles, the number produced by Dr. Lee is higher than some figures such as Prof. Kanwal, Prof. Jalaluddin and Prof BK Sen. Still, this comparison needs to be interpreted carefully given the differences in existence in the disciplines pursued. Furthermore, analysis in the Scopus database found that Dr. Lee was the researcher who published the most scientific articles in IMR (188 articles), which was 63 articles more than Dr Norazah Ahmad (125 articles) and 61 more than Dr Nazni Wasi Ahmad (127 articles).

He was found to be very productive after 11-20 years of service with his publication in local journals. However, the publication of his scientific articles decreased slightly during the service period of 21-30 years. Kousar & Mahmood (2010) reported the same findings in their study on Dr. Syed Jalaludin Haider, who noted that almost one-third of scientific articles were published during 21-30 years. Similarly, Koley & Sen (2006) also reported a similar finding where Prof. BN Koley published a similar proportion. This finding may be due to the accumulated experience and the networking established throughout Dr. Lee's involvement in medical entomology research.

Dr. Lee's coefficient of collaboration was also higher compared to figures such as Prof. Jalaluddin, Prof. BK Sen and the late Dr. Lim Boo Liat. This might be due to trends in the publishing world, where before 1975, single-author for one paper was dominant. However, it changed after the 1980s, when multiple authors for scientific articles were valued more. This trend was in line with the world of scientific article publishing, where the number of authors increased after 1975. In addition, it also showed that Dr. Lee's prominence was recognised in line with time, especially after 31 years in service, i.e. he was widely invited as a collaborator or consultant for the research projects. This statement is further strengthened by the fact that he published many scientific articles as the last author in international journals. In addition to the numerous awards he received during this period, he extended his service on a contract basis after the mandatory retirement age.

Dr. Lee's research themes changed over the years. We discovered that Dr. Lee started focusing on laboratory evaluation on research topics ranging from *Bacillus thuringiensis*, resistance gene monitoring in *Culex quinquefasciatus*, forensically important insect larvae, the transovarial transmission of dengue virus in *Aedes* mosquitoes and ULV-applied bifenthrin in vector control. After ten years, Dr. Lee's research themes extended to the chikungunya virus in *Aedes aegypti*, sterilization of *Lucilia cuprina* maggots in wound therapy, and dispersal and bacteria of the house fly. The insecticide studies were focused on the control of *Aedes aegypti*, *Aedes albopictus* and *Culex quinquefasciatus* with the deltamethrin WG and WP, malathion and permethrin. Dr. Lee and his team also dealt with the ovitrap surveillance of dengue and malaria vectors in Malaysia's Kuala Lipis, Pulau Ketam, Kuala Lumpur, etc. Keyword analysis indicated that after 20 years of service, Dr. Lee focused his research themes on genetically modified mosquitoes regarding mating compatibility, competitiveness with wild-type *Aedes aegypti*, forensic entomological studies, and maggot flies. The research on *Aedes albopictus* was mainly focused on the life table and detection of *Wolbachia* from field-collected *Aedes albopictus* in Malaysia, as well as their bio-efficacy evaluation of insecticide.

Moreover, Dr. Lee started a new research theme on releasing non-genetically *Wolbachia* strain *wAlbB* in the Malaysian population of *Aedes aegypti* for dengue control. After 31 years of service, his research themes were diversified as there were more local and international collaborators. Before pension, Dr. Lee continues to scrutinize the biological dengue control, including the Sterile Insect Technique (SIT) using gamma radiation at a permitted dose and the release of *Wolbachia*-infected mosquitoes' strategies to the field. His *Wolbachia* research was passed to his successors and was proven effective in dengue control. It was translated into the national operational programme in dengue control.

Nearly 95% of his scientific articles were cited by at least one publication, and his paper and H-Index were highly cited. These data indicated that the results of his publication were widely referenced in published articles in the discipline of medical entomology, thus indirectly acknowledging his immersed contribution to the body of knowledge in medical entomology research. In addition, he was also a mentor who guided young researchers in their careers. This was manifested from the keyword analysis that showed Dr Nazni Wasi, who was the co-author during Dr. Lee's service, being guided by him for the research and publications. Dr. Nazni has also become one of the prominent researchers in medical entomology both locally and internationally.

Dr. Lee is gifted for his innovation, perseverance and dedication to research, in which he successfully filed 17 patents as the results of his study, and resulted in the commercialization of the production of indigenous microbial control agent, Bti serotype H-14, development of a comprehensive test kit for the rapid detection of insecticide resistance, commercial production of *Bacillus sphaericus*, commercial development of a household insecticidal emulsion paint, development of a saliva-based rapid test kit for the detection of acetylcholinesterase, commercial production of sterile maggots of *Lucilia cuprina* for Maggot Debridement Therapy (MDT), kit for the rapid detection of dengue and chikungunya virus in mosquitoes, and Forensic Entomology Kit.

The commercialized products, especially the sterile maggots of *Lucilia cuprina* for MDT, are currently mass-produced by a local company to supply hospitals in Malaysia. The sterile *Lucilia cuprina* maggots can debride intractable ulcers in diabetic patients and were successfully tested on diabetic patients in collaboration with Hospital Kuala Lumpur from 2005 to 2008. This research study gained the highest recognition by winning the WHO's award of Dr. Lee Jong-wook Memorial Prize for Public Health on 25 May 2018.

Dr. Lee's long-term vision of the vector control intervention and direction instigated the research collaboration with the University of Glasgow in using biological *Wolbachia*-infected mosquitoes to control dengue, Zika and Chikungunya in the field release trial. Dr. Lee inspired, trained and supported his successors to continue the *Wolbachia* research project in Malaysia with the collaborative expertise provided by the University of Glasgow and the University of Melbourne, successfully scientifically proved that the strategy was able to reduce the dengue cases by 62.4% (CI 50-71%) in the field (Noor Afizah et al. 2015; Hoffmann et al. 2024). From translational research to operational, Malaysia has been the first dengue-endemic country to operationalize *Wolbachia*-infected mosquitoes using a replacement strategy worldwide since 2019.

In addition, Dr. Lee also contributed to preparing guidelines, including Western Pacific Regional Office (WPRO) Strategic Plan in Dengue Control for Programme Managers (Outcome of a WPRO meeting in Hanoi, November 2009), Guidelines for Space Spraying of Insecticides and Guidelines for Household Insecticides Testing (outcomes of WHOPES meeting in WHO Headquarters in Geneva, February 2009), Malaysian Standard Specification for Mosquito Vapourising Mat, Malaysian Standard Specification for Mosquito Electric Vapourising Liquid, Malaysia Standard Household Insecticide Products of Ant Bait - Evaluation Method for Biological Efficacy, Household Insecticide Products of Containerized Ant Bait and Cockroach Bait.

Dr. Lee's excellence in building international partnerships has positioned his leading Medical Entomology Unit as the WHO Collaborating Centre for Ecology, Taxonomy and Control of Vectors of Malaria, Filariasis and Dengue. The unit's strong track record has been instrumental in fostering future collaborations and earning the trust of the WHO. This trust led to the establishment of a Medical Entomology Good Laboratory Practice (GLP), pivotal in conducting bio-efficacy studies on vector control products, including laboratory, small-scale, and large-scale assessments against medically essential vectors. Since 2019, the Medical Entomology Unit has been certified as a GLP laboratory dedicated to evaluating vector control products in adherence to the standards set by the Organisation for Economic Co-operation and Development (OECD).

The paper had limitations; the citation of Dr. Lee's papers was based on the Scopus database, which was much lower than the actual number of Dr. Lee's publications. Therefore, Dr. Lee's contribution to the body of knowledge was underestimated. However, the primary data collection and comprehensiveness of secondary data collection enhanced the quality of this manuscript.

## CONCLUSION

The study revealed that Dr. Lee is an eminent researcher in IMR. Apart from translating his research findings into policies and products for the Ministry of Health Malaysia, he also expanded the frontier in medical entomology in Malaysia and other tropical countries through active collaboration and consultation.

## ETHICS APPROVAL

Ethical approval was not required as this is based on routine work and online resources.

## FUNDING

No funding was received for conducting this study.

## CONFLICT OF INTEREST

The authors declared that they have no conflict of interest.

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