

# **Robotic, Automation, and Human Resources in TVET**

**R. Derahman<sup>1\*</sup>, H. Husain<sup>1</sup>, Z. Che Wil<sup>2</sup> and M. Mazhar<sup>3</sup>**

<sup>1</sup>Jabatan Perdagangan,  
Politeknik Sultan Idris Shah,  
45100 Sungai Air Tawar, Selangor, Malaysia.

<sup>2</sup>Pusat Penyelidikan dan Inovasi,  
Jabatan Pendidikan Politeknik dan Kolej Komuniti,  
62100 Putrajaya, Malaysia.

<sup>3</sup>Faculty of Management Sciences  
University of Central Punjab,  
54000 Lahore, Pakistan.

\*Corresponding Author's Email: [rosmanizah@psis.edu.my](mailto:rosmanizah@psis.edu.my)

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## **Abstract**

Malaysia's aspiration to transition from a developing to a developed nation has spurred numerous strategic initiatives aimed at enhancing national productivity, economic resilience, and quality of life. Among these efforts is a strong emphasis on Technical and Vocational Education and Training (TVET) to support the country's evolving industrial landscape, especially in the context of robotics and automation. As foreign direct investment (FDI) contributions to GDP decline, Malaysia is shifting towards a resource-driven industrial growth strategy, exemplified by the New Industrial Master Plan 2030. This paper explores the intersection of robotics, automation, and human resource development within Malaysia's TVET ecosystem. With the emergence of institutions such as UniMAP, UMPSA, MMU, UNIKL, and the POLYCC network, Malaysia has made notable progress in embedding automation and robotics into the educational curriculum. However, rapid technological advancement has also led to significant shifts in human resource demand, raising complex questions about workforce sustainability, skills adaptation, and the future role of labor. The COVID-19 pandemic further accelerated the reliance on automation across various sectors, underscoring the need to align educational output with industrial needs. This study highlights the importance of enhancing the quality and relevance of TVET to ensure a resilient, skilled workforce capable of navigating technological disruptions, thereby supporting Malaysia's sustainable development goals. This paper reveals the trends in robotics, automation, and human resources, highlighting the prominent authors and countries that focus on these issues.

**Keywords:** Automation; Human Resources; Robotics; TVET.

## **1.0 Introduction**

Malaysia is currently still at the stage of a developing country. Various efforts have been mobilized to achieve the goal of becoming a developed country. After so long, the prestigious title can only be mentioned. However, with the change of various governance patterns, the status of a developed country remains the goal in the development engine. Being a developed country allows for various benefits that are obtained indirectly, such as the benefits of surplus money for development spending on infrastructure, which leads to an improvement

in the quality of life of the people in a controlled and sustainable environment, especially in services and human rights. A developed country also leads to a progressive high-income country and the advantages of technological infrastructure, which are closely linked to a sustainable economy and industry. With the advantages of a large domestic demand, a developed country that Malaysia dreams of will be an independent country that creates its supply and demand.

However, Malaysia is still working towards that with various efforts to increase national productivity. The public is aware of the national output that is measured by GDP (Gross Domestic Product) in every era, where GDP is the main indicator of national output. At the beginning of the country's economic growth, GDP was driven by foreign investment, namely FDI (Foreign Direct Investment). Investment contributed 40% to GDP, and that amount has been shrinking in line with changing times and government policies. Now, foreign investment, for example, has reduced to only 20% contribution to GDP. This situation is driven by growth and new policies, such as the New Industrial Master Plan 2030. This strategic plan targets industrial growth driven by national resources. This transformation plan has a general objective to increase productivity and skills, and income of the people. For this, TVET (Technical Vocational and Educational Training) has become an important platform and forum. Thus, this paper aims at (i) investigating the trends in robotics and automation in human resource, (ii) studying the most cited articles in robotics and automation as well as human resource (iii) exploring the top ten countries in the related publication.

TVET in Malaysia has been given a boost with the emergence of polytechnics, community colleges, skills training institutes, and MTUN (Malaysian Technical University), public and private universities. The most prominent is POLYCC, with a total of 36 polytechnics and 106 community colleges, which produced almost 32,000 graduates in 2022. This number has been able to supply the local workforce in the industry. The supply of TVET graduates, especially in the semi-skilled category, has made the industry's growth more vibrant.

However, at a time of rapid industrial growth with sustainability and industrial resilience resting on high production at lower costs, automation and robotics are among the recommendations and choices. Robotics and automation are the most strategic choices as labor costs are among the highest costs and overheads. With fierce competition in the global and open market, it certainly leads to perfect competition with the choice of maximum quantity at maximum cost. Automation and robotics can help in realizing the goals of the industry.

Facing this challenge, there are several TVETs that have already produced graduates in automation and robotics, such as Universiti Malaysia Perlis (UniMAP), Universiti Malaysia Pahang Al-Sultan Abdullah (UMPSA),

Multimedia University (MMU), and Universiti Kuala Lumpur (UNIKL). The same practice is also followed by POLYCC institutions (polytechnics and community colleges), which have begun to incorporate the same concept across their curricula, including offering a Diploma in Mechanical (Automation).

POLYCC also places a strong focus on robotics to the point of winning robot competitions at the national and international levels. Emphasis has also been placed on the curriculum, with the main components in the syllabus (Yusoff et al., 2020). Focus on SCADA, PLC, and DCS is given with an advantage to WBL (Work-Based Learning), and learning has also been implemented. Thus, preparations and preparations towards robotics and automation have begun. But what is the space for existing human resources? Human resource management is one of the most challenging areas of management (Irawanto et al., 2021). Not only is it a challenge in terms of costs and large expenses, but human resource management also involves more complex conflicts, including the development of management systems and discipline (Hassam et al., 2023). This management does three most important things: attracting capable employees, motivating them to work, and ensuring that they remain in the organization.

The movie 'Ugliest', which depicts a sustainable future, may be too extreme in its depiction. The depiction that only appearance is the only thing that cannot be controlled but can still be managed. However, technology, economics, globalization, and various factors can change the scenario of industry and life. Now we can see that the need for human resources has begun to be reduced. Among them is automation in various industries and even the need for human resources that are very close, such as service requirements. Using airline services, for example, we can see from the moment we book and buy tickets until we are on the plane. The Immigration Department has also begun to automate the country's entry and exit registration system. Maybe one day we will no longer need flight attendants to serve us food and drinks. Similarly, hotel services have also begun to automate the hotel registration and payment system. We can book online and check in using machines. The services that are said to require the friendliest are now also automated.

Human life will also continue to change (Aruldoss, 2020). The COVID-19 pandemic era has witnessed the fastest changes in human civilization. Dependence on technology has become stronger and has changed the way we work and live our daily lives. At that time, the explosion of technology was so rapid, and humans were able to adapt to it so well. In TVET planning and management, this is also seen as a challenge that needs to be addressed. In addition to MTUN offering various courses celebrating rapid changes in automation and robotics, education at POLYCC continues to pay attention to providing better semi-skilled labor. With the increase in the number of

institutions under POLYCC before 2023, 2024 will start with no more institution additions, but more investment will be made to add value and quality to all institutions under TVET.

POLYCC supplies the country's semi-skilled workforce with a variety of diploma and certificate-level courses. At the same time, additional courses for the PSH (Lifelong Learning) program continue to be strengthened. Making POLYCC popular can be among the agendas in its objectives. As a long-standing institution, POLYCC continues to maintain the quality of educational services with a variety of accreditations and evaluations. With general accreditations such as EOMS and ETAC, the quality of graduates is undeniable. The marketability rate is also always balanced with the number of entrepreneur graduates. For example, with an average marketability of 92%, the target rate of entrepreneur graduates has also been increased to 8%. This is evidence of the efforts of TVET institutions to strive towards improving the lives of the people. The objective of sustainability is also always prioritized, with various green efforts being enhanced. In short, in dealing with this era of robotics and automation, the improvement of the quality of the country's human resources continues to be strengthened. Therefore, Malaysia can be said to always strive in line with the times in strengthening the quality and quantity of national education. With effective planning and implementation efforts, Malaysia is expected to rapidly reach the status of a sustainable developed country.

Robotic automation, particularly Robotic Process Automation (RPA), is transforming Human Resources (HR) by automating repetitive, rule-based, and high-volume tasks. This shift allows HR professionals to focus on more strategic, human-centric activities, ultimately improving efficiency, accuracy, and the overall employee experience. RPA in HR involves the deployment of software robots that perform monotonous and high-volume tasks like candidate sorting, hiring, and employment data management (Balasundaram & Venkatagiri, 2020). This software both captures and interprets existing IT applications to enable transaction processing, data manipulation, and communication across multiple IT systems in back-office functions like HR (Anagnoste, 2017). RPA is a non-invasive technology that integrates well with existing enterprise IT landscapes, performing manual tasks in the background with little human intervention (Madakam et al., 2019).

## **2.0 Methodology**

This paper utilizes Scopus publication data using Bibliometric analysis, which involves organizing and analyzing bibliographic data from 2000 to 2025. This article analyzes the work being done which Scopus as a premier research platform to find, analyze, and share data from several fields such as sciences, social sciences, and humanities (Khiste & Paithankar, 2017).

This study utilized a screening sequence to determine the search terms for articles that have been retrieved. Search was initiated by querying the Scopus database with online TITLE-ABS-KEY (robotic AND (robotic AND automation) AND human resource, thereby assembling 715 articles. Afterwards, the query string was revised so that the search terms were “robotic” OR “human resource”. This process yielded 696 results, which were additionally scrutinized to include only research articles in English, and subject and article reviews were also excluded. The final search string refinement included 578 articles, which were used for bibliometric analysis. The table 1 is the research string used to analyse the data in the publication.

Table 1: The search string

Scopus	TITLE-ABS-KEY ( robotics AND automation AND in AND human AND resources ) AND ( LIMIT-TO ( SUBJAREA , "COMP" ) OR LIMIT-TO ( SUBJAREA , "ENGI" ) OR LIMIT-TO ( SUBJAREA , "MATH" ) OR LIMIT-TO ( SUBJAREA , "BUSI" ) OR LIMIT-TO ( SUBJAREA , "DECI" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) )
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The above search string was used in a Scopus database, and it has been supported by advanced Boolean logic, and the search has been limited to several fields. The search process was also limited to certain criteria, which are shown in Table 2 below. This process has been conducted, and several criteria were utilized to specify the data search.

Table 2: The selection criterion in searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Subject	Business Management, Social Science, Computer Science, Engineering, Decision Sciences	

### 3.0 Result and Discussion

The diagram below is a keyword co-occurrence network visualization, often generated using VOSviewer tools. It visually represents the relationships and thematic clustering of keywords extracted from academic publications on robotic automation in human resources.

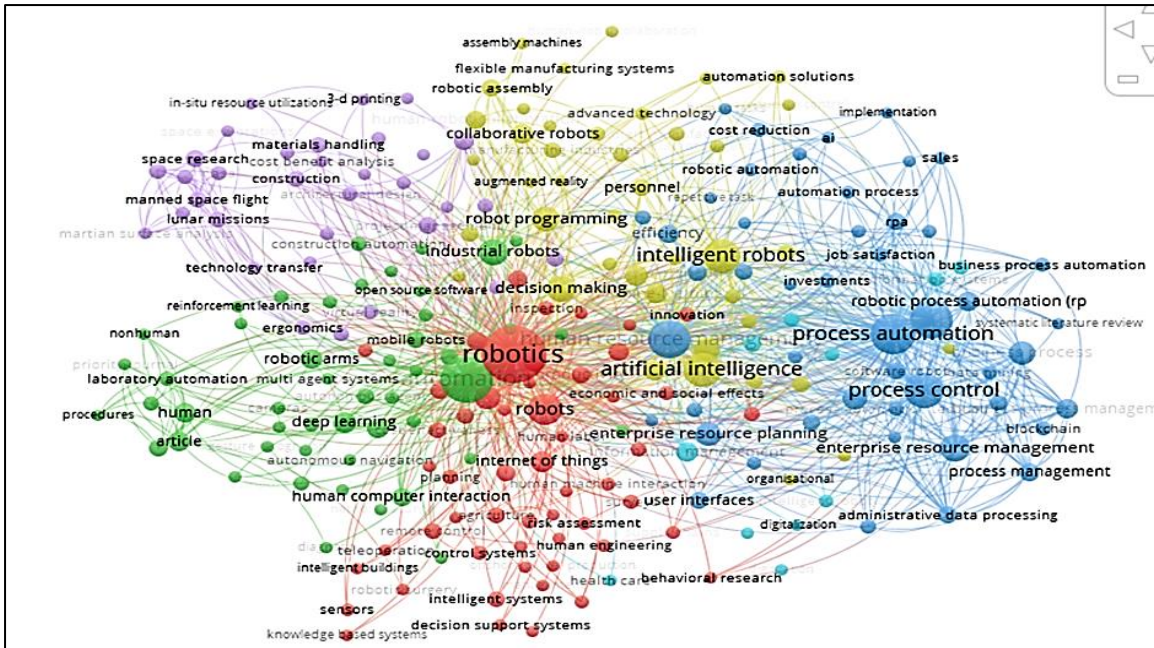


Figure 1: A flow chart of the feature selection heuristic

The nodes, colour, and edges represent keywords, clusters, and show the trends in articles in the SCOPUS publication. “Robotics,” “artificial intelligence,” and “process automation” are central and large, indicating they are highly prevalent and important topics. The bibliometric analysis, which has been performed, exhibited those nodes in publications from the year 2000 to 2025. The table below shows the publications in SCOPUS from the year 1983 to 2025. This graph shows the increasing trends of publication in this area involving robotics, automation, and human resources.

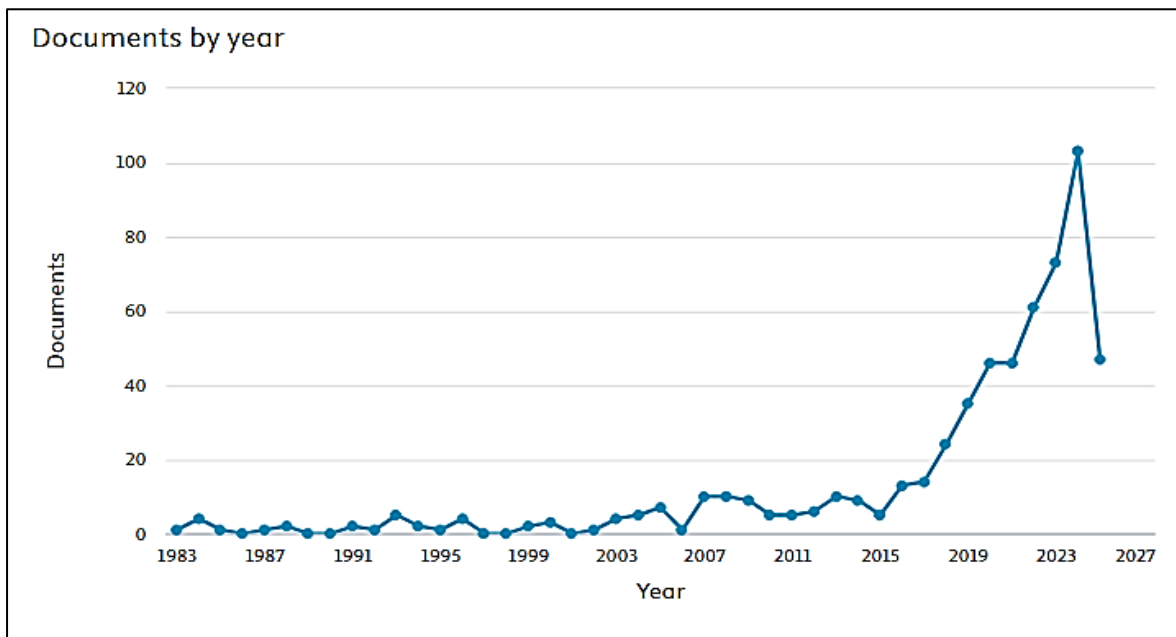


Figure 2: Documents by year in SCOPUS

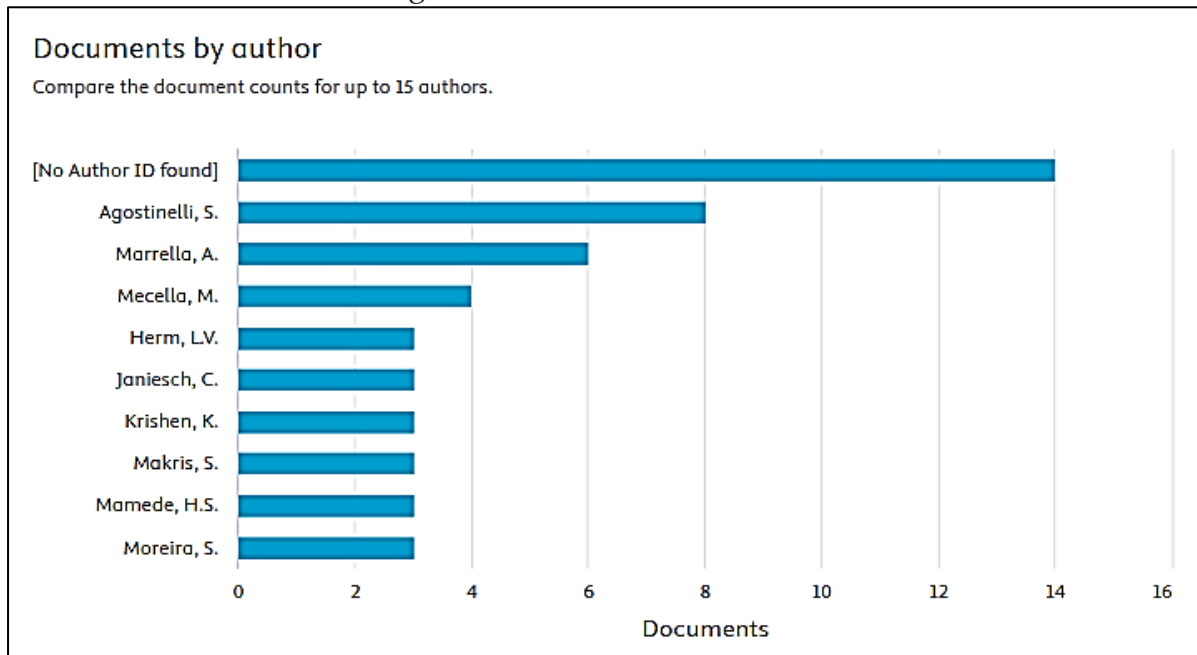
Table 3 summarizes several key authors and their contributions to the field of robotics, artificial intelligence (AI), and process automation. Among the most influential is Janiesch (2021), whose work on machine learning and deep learning has garnered a remarkable 1,785 citations, highlighting its foundational role in the integration of AI in business and digital transformation domains. Similarly, Mecella (2019) has significantly contributed to the field of process mining and automation through a comprehensive review and benchmark study on the automated discovery of process models from event logs, which has accumulated 332 citations.

Table 3: Main Authors

Authors	Title	Year	Source title	Cited by
Agostinelli, S.	Research Challenges for Intelligent Robotic Process Automation	2019	Biok: Business Information Processing	62
Mecella, M.	Automated Discovery of Process Models from Event Logs: Review and Benchmark	2019	IEEE Transactions on Data Engineering	332
Herm, L.V.	Stop ordering machine learning algorithms by their explainability! A user-centered investigation of performance and explainability	2023	International Journal of Information Management	90
Janiesch, C.	Machine learning and deep learning	2021	Electronic Market	1785
Krishen K.	Space applications for ionic polymer-metal composite sensors, actuators, and artificial muscles	2009	Acta Astronautica	64
Makris S	Symbiotic human-robot collaborative assembly	2019	CIRP Annals	455
Mamede H. S	Machine learning in software-defined networks: Data collection and traffic classification	2016	Proceedings International Conference on Network Protocols	146
Moreira S	Process automation using RPA literature review	2023	Procedia Computer Science,	29

Other notable contributions include Agostinelli et al. (2019), who discussed research challenges for intelligent robotic process automation (RPA), reflecting the growing intersection between robotics and business process optimization (Agostinelli, S., 2019). Herm (2023) provided a user-centered investigation into interpretable machine learning algorithms, underscoring the increasing focus on explainability and transparency in AI systems (Herm L.V, 2023). Although recently, this study has already gained 90 citations, indicating early but substantial academic interest.

Figure 3: Main cited authors



Research diversity is further exemplified by Krishen (2009), who explored space applications for smart sensors and actuators, linking robotics to aerospace technology (Krishen K, 2009). In the manufacturing context, Makris (2019) investigated human-robot collaborative assembly, a pivotal theme in Industry 4.0 research (Makris, S, 2019). Mamede (2016) focused on the application of machine learning in software-defined networking for data classification, emphasizing AI’s relevance to cybersecurity and network protocols. Moreira (2023) contributed recent insights into RPA through a systematic literature review. These publications reflect the breadth and depth of current robotics and automation research, ranging from industrial applications and space technology to data science and business process engineering. The above table also shows the 15 main cited authors in the publication since the year 2000. Figure 4 shows all 15 top countries that focus on and enhance their research and studies on robotics and automation in human resources.

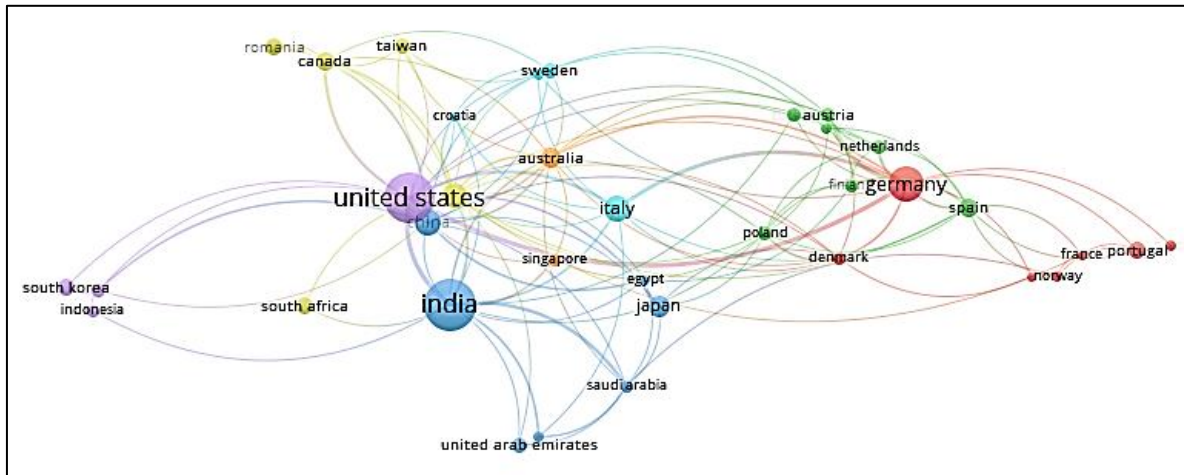


Figure 4: The top 15 countries

#### 4.0 Conclusion

The review of key authors and their contributions underscore the dynamic and multidisciplinary nature of current research in robotics, artificial intelligence (AI), and robotic process automation (RPA). Scholars such as Janiesch (2021) and Mecella (2019) have made substantial impacts through foundational work on machine learning and process mining, respectively, demonstrating the maturity of core AI technologies and their integration into enterprise systems. The high citation counts of these works reflect their academic influence and real-world relevance in driving digital transformation. Emerging research trends emphasize user-centricity and interpretability in AI systems, as highlighted by Herm (2023), whose work focuses on explainable machine learning. This signals a shift from purely technical advancements to more human-aligned innovations, reinforcing the importance of transparency and trust in AI deployment. Furthermore, Agostinelli et al. (2019) and Moreira (2023) illustrate how RPA is evolving as a central theme in automation studies, bridging the gap between intelligent systems and business process optimization.

However, there are limited publications on human resources that involve robotics and automation. Research shows that there is a future requirement for human resources to be managed and automated using AI (Madakam et al., 2019), and the back-office operations have already embarked on AI usage (Anagnoste, 2017). In achieving sustainable human resources, there is need to emphasize the sources of both manual and digital (Macke & Genari, 2019). The inclusion of diverse applications, from space exploration (Krishen, 2009) to human-robot collaboration in industrial contexts (Makris, 2019) and software-defined networking (Mamede, 2016), further highlights the versatility and expanding scope of robotics research. Collectively, these contributions reveal a robust and evolving research landscape that not only advances technological capabilities but also addresses practical challenges across multiple sectors. This growing body of literature lays a critical foundation for future innovations that are intelligent, efficient, and ethically grounded.

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## Author Contributions

**R. Derahman:** Conceptualization, Abstract, Introduction, Analysis, Results; **H. Husain**, **A. Abd Aziz:** Data Collection, Conclusion, Recommendation, **Z. Che Wil:** Reviewing and Editing; **M. Mazhar:** Reviewing and Colaborator

## Conflict Of Interest

The manuscript has not been published elsewhere and is not under consideration by other journals. All authors have approved the review, agree with its submission and declare no conflict of interest in the manuscript.

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