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Cardiovascular Disease Risk Factors among White-Collar Workers towards Healthy Communities in Malaysia

Suziyanti Marjudi, Roziyani Setik, Raja Mohd Tariqi Raja Lope Ahmad, Wan Azlan Wan Hassan @ Wan Harun, Syahirah Ismail

Abstract: ***Cardiovascular disease (CVD) is the most common cause of mortality worldwide, including in most Western countries and Asian countries such as Malaysia. Reports by The Department of Statistics Malaysia highlighted that ischaemic heart diseases and cerebrovascular disease, which are a few of CVD, was the principal cause of death in 2016 and 2017. At the same time, big data is a part of Malaysia's fast-growing technology and has grown prominently in the six Malaysian government's public sector clustering which are profiling, social, economy, transportation, education, and also in healthcare. This paper focuses on healthcare big data, which is a prime example of how the three Vs of data, velocity (speed of generation of data), variety, and volume, are an innate aspect of the data it produces. Most healthcare data analytics has been conducted in the United States and Europe, however there were some studies in Canada and very little in Asia. This study will be conducted in Selangor, Malaysia focusing on white-collar workers among the Selangor healthy community. Interviews will be held within medical practitioner or healthcare provider in order to collected information. The information available from the National Cardiovascular Database (NCVD) published reports will be used to conduct the data analysis experiments which will lead towards the identification of CVD risk factors. The results obtained show that data crawling of social media data can be used as a means towards healthcare big data analytics. This will hence aid in the Malaysian healthcare integration process and aid the Malaysian government to provide better healthcare for the overall Malaysian healthy community and society.***

Keywords*: *Cardiovascular Disease, Malaysia CVD Prevalence, Healthcare Big Data Analytics, Social Media Data Crawling

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***** Correspondence Author

Suziyanti Marjudi*, Faculty of Communication, Visual Art and Computing, Universiti Selangor (UNISEL) Malaysia Email: suziyanti@unisel.edu.my

Roziyani Setik, Faculty of Communication, Visual Art and Computing, Universiti Selangor (UNISEL) Malaysia Email: roziyani@unisel.edu.my

Raja Mohd Tariqi Raja Lope Ahmad, Faculty of Communication, Visual Art and Computing, Universiti Selangor (UNISEL) Malaysia Email: rmtariq@unisel.edu.my

Wan Azlan Wan Hassan @ Wan Harun, Faculty of Communication, Visual Art and Computing, Universiti Selangor (UNISEL) Malaysia Email: wan.azlan@unisel.edu.my

Syahirah Ismail, Faculty of Communication, Visual Art and Computing, Universiti Selangor (UNISEL) Malaysia Email: syahirah@istudent.unisel.edu.my

I. INTRODUCTION

Cardiovascular Disease (CVD) is a group of diseases related to the cardiovascular systems such as the heart, blood vessels, and also diseases that links from the heart to the lungs and brain [1]–[3]. It is also alternatively labelled as heart disease [1] and have been labelled differently throughout history [4], [5]. Hypertension, coronary heart disease, cerebrovascular disease, peripheral vascular disease, heart failure, rheumatic heart disease, congenital heart disease, and cardiomyopathies are also considered CVDs [2] and represent 31% of global deaths [2], [6]. It is also the number one global burden of disease and is prevalent for both male and female, with male statistics of CVD deaths being higher than women [3], [6], [7]. The total global cost of CVD to the global economy is $863 billion (RM3644 billion) [6].

II. CVD IN THE GLOBAL WORLD

According to history, CVD is discovered early on during the times of the Egyptian Pharaohs [4], [8], which was around 1200 BCE and even before that, 9 out of 16 pharaohs suffered atherosclerosis where their arteries have high deposition of fatty material on its inner walls. During the 14th Century, Leonardo Da Vinci studied coronary arteries [4], [9], while from the 15th to 17th Century it is further studied by William Harvey and Friedrich Hoffmann respectively [4], [10], [11]. From 18th to 19th century, it is still prevalent as angina or tightness in the chest [4], [12]–[14]. After the tuberculosis outbreak, CVD continued its prevalence starting from its rediscovery within the 20th century in United States of America until its global spread in the 21st century [4], [5], [15]–[17].

Studies show that the known risk factors of CVD are mainly a result of poor management of behavioural risk which is usually a result of habits from unhealthy communities [2], [3], [7].

These behavioral risks are mainly unhealthy diet, physical inactivity, tobacco use, harmful use of alcohol, which leads to diabetes, hypertension, dyslipidemia, and many more diseases which contributes to CVD [2]. Other underlying determinants also includes globalization and urbanization, which leads to the rising numbers of white-collar workers within the global population [2], [5], [16]. Besides that, other determinants include population ageing, stress, and hereditary tracks [2]. In fact, poverty also causes CVD as it is 80% prevalent in low-income and middle-income countries [2], [6].

CVD is mainly worse in low-income and middle-income countries due to scanty integrated primary healthcare programs for early detection, early treatment, and less access to healthcare services [2], [16], and this is a problem as low and middle-income countries make up 62% of the world's poor [2]. Late detection and high out-of-pocket expenditure causes death in these countries during productive years [2].

Besides that, low-income and middle-income countries are countries striving towards economic growth in this era of globalization. A study shows that the more a country increases its globalization and urbanization, the higher its physical inactivity as higher positions reduces physical activity time, hence leading to increased percentages in obesity and CVD [18]. It is due to these catastrophic information that the World Health Organization (WHO) launched the Global Action Plan for Prevention and Control of Non-Communicable Disease (NCD) from 2013, with the hope that the global death number due to CVD will be reduced to 25% by 2030, especially for low-income and middle-income countries.

Lower middle-income countries have a Gross National Income (GNI) per capita between $1,006 and $3,955, while upper middle-income countries GNI are between $3,956 and $12,235 [19].

Malaysia in 2020 is an upper middle-income country and is expected to be a high-income country by 2030 [20]. Malaysia's GNI in 2018 is $10,460 (RM44,251) with the number rising since 1962 [21], ranking Malaysia 55th out 157 countries in World Bank's Human Capital Index. Despite these achievements, CVD is the number one cause of death in Malaysia [22] with 76% of urbanization and 27.6% of white-collar workers [18], [22], [23].

White-collar workers are defined as office workers or office related workers, while blue-collar workers are physical laborers [24], [25]. Malaysia is 27.6% white-collar workers and 72.4% blue-collar workers [26], [27]. The classification of these working class is according to guidelines by The Department of Labor, Ministry of Human Resource Malaysia [28], which is also in-line with International Standard Classification Of Occupations 1988 (ISCO - 88). With the rate of Malaysia's urbanization, then the CVD prevalence has also increased.

III. CVD AND IT'S PREVALENCE IN MALAYSIA

The total prevalence of CVD in Malaysia has almost doubled between 2005 to 2018 [29]. In 2018, CVD is the number one medically certified cause of death and principal cause of death in Malaysia [22]. Death by ischaemic heart disease is 18,267 and death by cerebrovascular disease is 9,154, with 17.8% of it is CVD deaths of male and 12.2% more are CVD deaths of female [22], [30], [31]. This is followed by 2,187 of death by hypertensive disease and 2,917 by diabetes mellitus, which all falls under the category of risks leading towards CVD [32].

Studies show that overweight and obesity rate will increase among socioeconomically average in Malaysia, with increasing percentage of hypertension, diabetes, dyslipidaemia and metabolic syndrome due to unhealthy community and unhealthy diet [30], [31], [33]–[35].

By ethnic group, CVD in 2018 killed 15.2% Bumiputra, 14.8% Chinese, and 20.7% Indians [22].

A study in Selangor showed that these numbers when compared against health literacy puts Chinese elderly CVD deaths as the worse statistics in terms of self-care [35]. This is because Chinese elderly have low health literacy when compared to Malay and Indian elderly, even though they have positive attitude in searching and retrieving information and medications related to CVD. Statistically, 16.6% of CVD deaths are from elderly older than 60 years old, while 19.2% of CVD deaths are between are 41 to 59 years old [22].

There are also studies showing the importance of health literacy and self-care, which highlights that health literate society need to be done in order to improve healthcare costs as a whole [36], [37] and Malaysia elders have poor rate of technological embracement, as Malaysian elders feel that managing healthcare through technological applications are complex and time consuming [35], [38], [39].

Therefore, health literacy and good self-care management, especially when dealing with a CVD patients' age, can be considered as risk factors of CVD. It can also be derived as CVD prevalence in adults majorly occur near the age range of elderly, therefore it's risk factors and underlying determinants can be seen during the age between 20-40 years of age, especially behavioral risks.

In terms of tobacco use and harmful use of alcohol, Indian households have a higher usage of tobacco and alcohol, with the percentage being higher in blue-collar worker households than white-collar workers, while Chinese households have a higher usage of tobacco and alcohol only when the household income is higher and other ethnics have higher percentage of tobacco and alcohol usage if the head of the house is not an elder [40].

The total usage of tobacco and harmful use of alcohol in Malaysia is relatively low compared to other countries as Malaysia is an Islamic country and has strict policies regarding smoking and vaping, as well as strategies against harmful alcohol use.

However, based on these reviews, the main risk factor of CVD in Malaysia is unhealthy diet and physical inactivity due to sedentary lifestyle rather than tobacco use and harmful alcohol use.

Besides that, Malaysian population by 2020 is 77.2% urban population and 22.8% rural population, with urban annual population growth of 2.1% and 10% urbanization growth rate since 2004 to 2018 [23], [41]–[43]. However, the percentage of death by CVD in 2018 in both areas are approximately the same, with a combination of death by ischaemic heart disease and death by cerebrovascular disease at 23.2% in urban areas and 23.7% in rural areas [22].

This shows that CVD in Malaysia affects both rural areas and urban areas with the same magnitude. This also shows the effect of globalization, as advancement of life amenities and the economic growth in both rural areas and urban areas have increased.

By 2020, both rural areas and urban areas in Malaysia have access to electricity, clean fuels, and cooking technologies, with ample job opportunities for both blue and white-collar workers [23], [41].

This development will also lead towards technological advancement which will decrease physical activity, with urban areas having more impact on physical inactivity than rural area.

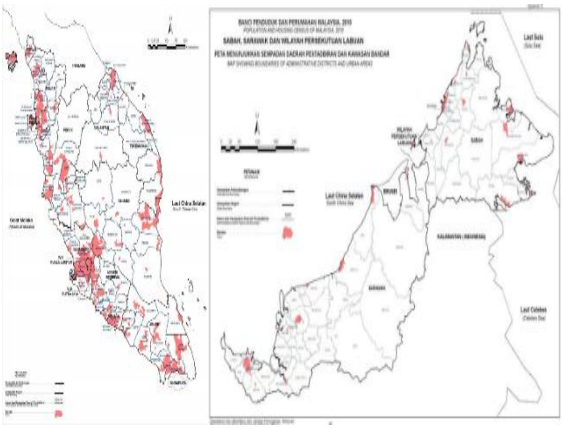

Fig.1. Urban Population Distribution in Malaysia (visualized in pink), with more than 95% of Malaysia being rural areas [43]

Malaysia has a total of 14 states and 3 federal territories. Selangor is a state with 9 districts and is one of the top 6 states in Malaysia that contributes to 72.1% of Malaysia's Gross Domestic Product (GDP) [1], [2]. With 91.4% level of urbanization by 2010 and the highest population distribution in the country, Selangor is a vastly populated state with a population density of 819/km2 [2], [3]. However, the state has 68.2% white-collar workers and has CVD deaths as its number one principal cause of death [1], [4], despite having active healthy communities, beneficial healthcare programs, and a high number of medical institutes.

IV. METHODOLOGY

Interviews are conducted within medical practitioner or healthcare provider in order to collected information. The information available from the National Cardiovascular Database (NCVD) published reports are also used to conduct data analysis experiments that will lead towards the identification of CVD risk factors. The NCVD is an ongoing Malaysian CVD integrated database available in the country that was officially launched in order to manage, analyze, and interpret a nation-wide cardiovascular database. The data analysis is using exploratory data analysis and text analytics.

V. CVD, WHITE-COLLAR WORKERS AND HEALTHY COMMUNITIES OF SELANGOR STATE

In Selangor state, the top 5 medically certified principal causes of death for 2017 are cerebrovascular disease, ischaemic heart disease, malignant lung neoplasm, pneumonia, and transport accidents.

The alarming findings is that 53.72% of the total principal causes of death for 2017 are CVD, 16.89% being cerebrovascular disease and 36.85% being ischaemic heart disease [4].

Figure 2 shows the urban population distribution in Selangor in 2020, while Table I shows the district population, urban population, rate of death, and the number of principal causes of death by district in 2017. The 9 districts in Selangor are Gombak, Klang, Kuala Langat, Kuala Selangor, Petaling, Sabak Bernam, Sepang, Hulu Langat, Hulu Selangor [1]

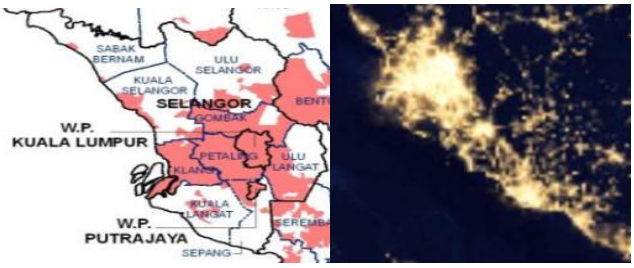

Fig.2. Urban population distribution by district in Selangor (visualized in pink), where most of the urbanization is centered in Petaling, Gombak, Klang, and Sepang district in 2020 [43]

Table 1: District population, urban population, rate of death, and the number of principal causes of death by district in 2017 [26], [43], [46], [47]

District	Total Population	Death Rate (%)	Cerebrovascular Disease	Ischaemic heart disease	Malignant lung neoplasm	Pneumonia	Transport Accident
Gombak	815,200	4.3	129	305	54	234	100
Klang	1,025,100	4.5	205	422	78	317	159
K. Langat	270,300	5.3	61	99	18	110	71
K. Selangor	251,200	5.5	57	140	19	94	56
Petaling	2,157,000	3.6	333	715	158	454	149
Sabak Bernam	121,100	8.4	46	85	16	86	47
Sepang	256,900	3.4	35	62	13	42	33
Hulu Langat	1,370,200	4.1	232	547	89	490	121
Hulu Selangor	237,600	5.1	50	123	16	88	47
TOTAL	**6,504,600**	**AVG =4.9**	**1145**	**2498**	**437**	**1917**	**786**

From Table 1, the highest counts of CVD deaths are in the centre of the urban population distribution as shown in Figure 2. In the district level and looking at the general cause of death, Sabak Bernam has the highest death rate out of all other districts with the least urbanization population distribution, followed by Kuala Selangor, Kuala Langat, and Ulu Selangor. This may be since it is the further away from highly dense urban populations in Figure 2, especially Sabak Bernam. This finding is significant as most general hospitals, especially specialist hospitals with the correct equipment for chronic diseases such as CVD are near the central district distribution in Figure 2.

Therefore, access to healthcare not only relies on health literacy and technology literacy, but also the geographical location of specialist healthcare institute to other less urbanized areas or rural areas. By 2017, Selangor has 14 hospitals, 83 health clinics, 115 rural clinics, and 49 Malaysian clinics [4]. However, specialist hospitals and clinics that specialized in CVD with proper equipment and treatment programs are usually in hospitals and in some specialist clinics. So geographical access to healthcare can also be one of the risk factor CVD.

In terms of number of deaths, CVD deaths are highest in highly urbanized populations, starting with Petaling, and then followed by Hulu Langat, Klang, and Gombak. High urban populations have higher cost of living and have more white-collar workers [2], [3], [5], [6]. The average monthly cost of living in Selangor in 2018 is $1,223.10 (RM5,183) per month, with the highest out-of-pocket household expenditure on housing, electric bills, water bills, gas, and fuel, followed by food and non-alcoholic drinks, restaurants and hotel, transportation, and house furniture and maintenance [2]. The least expenditure is alcohol and tobacco, suggesting that Selangor has low percentage of harmful alcohol use and tobacco use. The cost of living shown will impact differently on different classes in Malaysia. Table II shows the national average household income against Selangor average household income of the three classes.

Table 2: National average household income against Selangor average household income of the three classes [44], [48]

Median Monthly Income by Household Group (2016)		
Group	**Malaysia**	**Selangor**
B40	RM3,000	RM4,395
M40	RM6,275	RM8,585
T20	RM13,148	RM17,410

Although Selangor has a higher median monthly income when compared to the national median monthly income, the out-of-pocket expenses per month are still higher than the household income, especially for the B40 group. The high median monthly income can be correlated to the number of white-collar workers in Selangor, as white-collar workers have higher monthly pay when compared to blue-collar workers. Selangor has 68.2% white-collar workers [2]. Nevertheless, the gap between the monthly income and monthly expenses will create a stressful situation for both blue and white-collar workers in Selangor, especially as living expenses in urban areas are relatively higher as the population increases. The stress makes them work more in order to close the gap between the expenses, which makes them have lesser sleep, become physically inactive, and have unregular eating patterns, hence leading them to have unhealthy diet, low physical activity, and a sedentary lifestyle [7]–[12].

In the aftermath, a health program known as PEDULI Sihat has been created by the Selangor government to cater for this problem, reducing monthly expenditure of healthcare to RM91 monthly and ensuring B40 receive financial aid through PEDULI's Bantuan Sihat Selangor [12]–[15]. Healthy community in Selangor are also managed through the "Komuniti Sihat, Pembina Negara" (KOSPEN) program, which was created by the Selangor government in 2013 in order to control NCDs in the state [16], [17]. KOSPEN plays a vital role in promoting healthy communities in both Selangor and Malaysia alike. Healthy communities are a community that continually creates and improves its environment and resources in order to create more health awareness and healthy lifestyle within the community itself, which includes health environment, health access, health education, and even advocate for better life amenities to its country's governing body [18].

A study showed that the success rate of KOSPEN Selangor is higher in working and higher educational level individual, which means that KOSPEN are well received amongst white-collar workers [19]. However, due to health literacy issue, the burden of keying-in the data have fallen to KOSPEN volunteers, which the KOSPEN community mistakenly understood as treatment officers, whereas they are only ground level screening officers that detect early abnormalities within the community. KOSPEN is still in its First Phase of implementation [16], [17], [19]. However, more efforts within the healthy community need to be incorporated in terms of health information and technological literacy in order to tackle CVD prevalence in both Selangor and Malaysia, as better information and understanding of a disease will generate positive and healthy behaviour among the community [20].

VI. MALAYSIA'S READINESS FOR HEALTHCARE BIG DATA ANALYSIS

The scope to determine the readiness for implementation of Healthcare Big Data Analysis into the Malaysia's healthy community is divided into resource readiness, governing readiness, and community readiness. In terms of governing readiness, the Ministry of Health have been given an allocated budget of $45.93 billion (RM193.6 billion) by the government in 2019 and the ministry has focused its incentives mostly on health policies and administrative management [24], [25]. Policy-wise, Malaysia has National eHealth Strategy 2014 created to better manage Malaysian healthcare environment in terms of healthcare technology; National Policy for Science, Technology and Information 2013-2020 to better integrate ICT into all fields; Health Technology Assessment (HTA) to evaluate the properties, effects, and other impacts of healthcare interventions such as technology; and the Personal Data Protection Act 2010 (PDPA) in order to maintain the privacy of personal data, especially healthcare profiles of Malaysian individual [25]–[28]. In terms of community readiness, studies have already established the usefulness of KOSPEN. Studies also show that drivers of ICT in healthcare includes government thrust, physician acceptance,

and user adoption [29]. Since government thrust has been established, then physicians and users are the next part of healthy community that needs to be focused in terms of technological readiness. Statistics in 2018 also show that Malaysian users are accustomed to ICT use as at individual level, 81.2% uses internet, 70.5% uses computer, and 97.9% uses mobiles phones, awhile at household level, 87% uses internet, 71.7% uses computer, and 98.2% uses mobile phones [30]. Studies also show that 83.1% is used to find information and 96.5% of internet is used to access social network, with a high rating of response for when the social network interaction is used for healthcare [30], [31].

Studies also show that health-related internet use is high when there is a high perceived of health risk, health consciousness, perceive of information usefulness, perceive in trust, and positive perceived cost and medical expenses, especially for urban population [23], [32]–[35]. This shows that it is possible to crawl social media data for use of healthcare big data analysis. As for elders, they have no problem adopting to technology as long as there are expert advice to aid in effort expectancy [35], [36]. Medical personnel also shows acceptance for ICT use in healthcare and increase in user satisfaction provided that there is an overall integration between human, organization, and technology [37].

Next is in terms of resource readiness. In healthcare big data analytics, the resources needed are hospital records, medical records of patients, results of medical examinations, devices that are part of Internet-of-Things or social media data, and trend data such as weather data [38]–[40]. Hospital records, medical records of patients, and results of medical examinations can be obtained from the Malaysian Health Data Warehouse (MyHDW), Health Information Management System (HIMS), Patient Registry Information System (PRIS), Unified Teleprimary Care and Oral Heathcare (TCP-OHCIS), and Food Safety and Services Malaysia [41]–[43][41], [42], [44]. As for infrastructure, Malaysian infrastructure is capable of implementing Big Data Analytics [29]. In summary, Malaysia's healthy community readiness for healthcare big data analytics is high as there is enough readiness in terms of resources, governance, and community.

VII. MALAYSIA HEALTHCARE BIG DATA ANALYTICS (BDA) AND ITS CHALLENGES

By 2020, big data analytics is the fastest growing technology in Malaysia and is a large part of 10 trends to drive the Malaysian economy as well as the world [43], [45], [46]. In Malaysia, big data analytics is used to gain a much detailed insights of each data pattern, make more precise predictions, generate a much accurate recommendation for decision making [38]–[40]. The growth rate of the technology is set to make Malaysia the Southeast Asian hub on big data analytics, with multinational big data analytic companies setting up and exporting services [47], [48]. The current use of big data analysis in Malaysia is Public Sector Big Data Analytics (DRSA), Public Sector Big Data Analytics (DRSA) Expansion, Public Sector Big Data Analytics 2.0 (DRSA 2.0), Machine Learning Training, Government Data Optimization and Transformation Services (GDOTS), and Big Data Analytics Digital Government Lab (BDA-DGL) [49].

The Malaysian healthcare big data analysis is covered under BDA-DGL, where successful projects until February 2020 are Malaysian Health Data Warehouse (MyHDW), Health Information Management System (HIMS), Patient Registry Information System (PRIS), Unified Teleprimary Care and Oral Heathcare (TCP-OHCIS), and Food Safety and Services Malaysia [43]. This is to provide effective and affordable healthcare services and programs to Malaysian citizens. Under DRSA, the Ministry of Health Malaysia are able to predict contagious disease spread and create suitable prevention solutions. This will in turn increase Malaysia's healthcare capacity especially when there are shortage of medical personnel, strategies to increase population ageing and life expectancy, improvement in healthcare infrastructure and technology, rapid adaption to smart-phone, transformation of healthcare via ICT-based delivery system and a more integrated healthcare system under MyHDW [29], [38], [48]–[50].

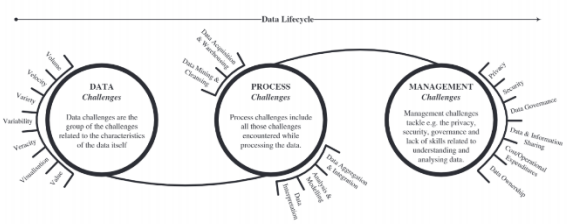

Fig. 3: Healthcare Big Data Analytics Challenges [90]

However, any system or service is not allowed to extract personal data without the owner's consent [28]. A bigger concept of big data to understand is that there is a large volume of valuable, varying, and reliable data that are at-rest and in-motion, moving at speed each time a data is recorded in real-time [51]–[53]. Therefore, each use of the data needs to adhere to PDPA. There are also other challenges in healthcare big data analytics as shown in Figure 3, but for Malaysia, the main challenge is PDPA [38], [48], [50]. Studies have shown that the PDPA and data security issue can be addressed by implementing anonymization using k-anonymity and generalization with data compression; data perturbation; cryptography for de-identification, advanced encryption, and virtual fencing; and Data Management Framework for information and resource management for a much secure access and safe keeping [54], [55].

VIII. CONCLUSIONS

CVD prevalence in Selangor alone proves that Malaysian healthcare needs to further develop big data analytics technology into its healthy community. Studies have shown that healthy community are a part of Malaysia's primary healthcare movement and can promote better health engagement, preventive health service, and encourage better healthcare and self-care behaviour into everyone within the community [21]–[23]. In order to reduce CVD prevalence in Malaysia, the country needs to increase it's resource readiness, governing readiness, and community readiness. Since CVD prevalence in Malaysia starts at the age of 41 and above, then the behavioural risk needs to be managed at earlier ages prior to that. WHO has outlined that mental resilience at a younger age will increase healthcare awareness and adoption, which will then lead towards better understanding, management,

rate of recovery, and adaptability throughout their lives [20]. This mental resilience can be nurtured by sharing healthcare information using information, communication, and technology (ICT) amongst both public user and medical personnel, and then analysing data of those interaction with health-related information found online to better understand the total readiness of Malaysia to incorporate big data analytics into the Malaysia's ICT based healthcare community. Future research may also go more in depth in social media data crawling with other Malaysian government's public sector clustering besides healthcare in order to further understand other behavioral risks and underlying determinants of CVD prevalence in Malaysia.

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AUTHORS PROFILE

Suziyanti Marjudi received her PhD from Universiti Kebangsaan Malaysia (UKM) and Master of Science (Information Technology – Manufacturing) from Universiti Teknologi Malaysia (UTM). She joined Universiti Selangor in 2004 and is currently a Senior Lecturer at Computing Department, Faculty of Communication, Visual Art & Computing. Her research interests are in Big Data Analytics, Supply Chain Management, Data Exchange, Small and Medium Enterprises and Quality Assurance/Control.

Roziyani Setik has been a lecturer in the Department of Computing, Visual Art Faculty, Communication and Computing at Universiti Selangor since 2007. She holds Msc. in Information Management from the Universiti Teknologi Mara, Shah Alam. Before that she graduated in Bachelor of Computer Science from Universiti Putra Malaysia. She is interested in studying big data especially analyzing sentiments on certain topics from social media.

Raja Mohd Tariqi Raja Lope Ahmad. He obtained his bachelor degree in Information Technology from Northern University of Malaysia (UUM). Master of Business Administration (MBA) from Universiti Teknologi Malaysia and Cranfield University. His PhD in Industrial Computing from Universiti Kebangsaan Malaysia (UKM). His research area related to the area of Information System, Enterprise Resource Planning and Supply Chain Management.

Wan Azlan Wan Hassan @ Wan Harun. He received the B.I.T (Hons) in 1997 from Northern University of Malaysia (UUM) and Master in Computer Science (Software Engineering) in 2000 from the Universiti Teknologi Malaysia (UTM). From 1997 to 2002, he joined several manufacturing based company as a Programmer and Software Engineer. He obtained his PhD in Computing from University of Selangor in 2019. In 2002 till now he was with University Selangor as a Senior Lecturer. He is now actively doing research in Halal Supply Chain Management Systems.

Syahirah Ismail. She obtained her Bachelor of Sciences in Information Technology with Supply Chain Management from Universiti Selangor (UNISEL). She is currently pursuing her Masters research in Computing, focusing on Halal Industry 4.0, Big Data Analytics and Halal Transactions. She is interested in Industrial Computing, Supply Chain Management, Refinement of Economics, Change Management, Risk Management Practices, and also policies that can be integrated between each component to the other.