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A Mixed-Method Analysis of People's Perception and Behaviour on Vaccination Program in Online Social Media

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ABSTRACT

Introduction: Social media has been a major source of various parties obtaining misinformation about vaccination programs and it has raised doubts about the vaccine, especially among parents. Vaccine hesitancy was listed as one of the top ten issues that threaten global health by the World Health Organization (WHO) in 2019. Therefore, this study aimed to examine sentiment on vaccines from Facebook pages, focusing on Facebook users' views on vaccination programs through a mixed-method approach, which is a qualitative and quantitative combination analysis. **Methods:** This analysis uses all comments posted on Facebook pages downloaded using Facepager software from 01 December 2020 to 31 December 2020. R software is used to clean the comments and performed the sentiment analysis, while Gephi software is used to perform the semantic network analysis. **Results:** Out of 5,055 comments, the majority of the comments are negative sentiment (49.33%), followed by positive (32.58%) and neutral (18.08%) sentiment. For the negative sentiment, *tolak*, *mati*, and *cucuk* were the most frequent words ever used. For the positive sentiment, *terima*, *setuju*, and *selamat* were the most frequent words ever used. The positive network centered around the word *dajjal* focused on the word *lab* and *FDA*. In contrast, the negative network centered around the word *vaksin* focused on the word *semulajadi* and *kerajaan*. **Conclusion:** These findings are useful to understand the problem of parents who are skeptical of the vaccination program and also can be a guide for public health to communicate with the public through social media.

Keywords: Vaccine Hesitancy, Sentiment Analysis, Semantic Network Analysis, Social Media.

INTRODUCTION

Children vaccination is one of the best strategies and cost-effectiveness in public health to prevent child mortality caused by infectious diseases (Ahmad *et al.*, 2017). To date, two initiatives on children's vaccination have been introduced globally, which are the Decade of Vaccines and the Global Vaccine Action Plan (Macdonald *et al.*, 2014), and locally in Malaysia, children's vaccination is known as the National Immunization Program, overseen by the Ministry of Health (MOH), who is responsible to provide free-of-charge vaccination services to all Malaysian children in all MOH facilities. Under this program, parents are provided with a schedule of vaccination as a guideline that the parents must follow. To date, the vaccination coverage in Malaysia has achieved more than 95% among the infants and young children who have completed the vaccination program is about 86.4% (Azizi *et al.*, 2017; Lim *et al.*, 2017).

Nonetheless, there are loopholes in the law to make parents vaccinating their children compulsory (Asari *et al.*, 2018) and most likely became an attribute to the failure of the parents to comply with the childhood vaccination schedule (Abdullah, 2016). Malaysia recorded 18 cases of diphtheria two deaths in Kedah and Malacca in June 2016 (Abas, 2016). These adverse events have not met the main goal of the Global Vaccine Action Plan, which is targeted to reduce child mortality world widely (Macdonald et al., 2014). Furthermore, the number of parents who refused to vaccinate their children has increased day by day in Malaysia (Rumetta *et al.*, 2020).

Vaccine hesitancy is a major cause of the worsening risk of disease outbreaks in the United States where vaccination coverage does not reach optimal levels (Zipprich *et al.,* 2015). In addition, vaccine hesitancy was listed as one of the ten issues that threaten global health by the World Health Organization (WHO) in 2019 (Deiner *et al.,* 2019). Vaccine hesitancy has three components that influence an individual's refusal, delay, or reluctance to vaccinate even though having active concerns; these are behaviors, beliefs, and attitudes (Kang, Culp, *et al.*, 2017; Peretti-Watel *et al.,* 2015). The intervention program for vaccination refusal is the best strategy to find out the reasons for parents not to vaccinate their children and at the same time try to advise parents to return to vaccinate their children (Chan *et al.,* 2018), however, the study was only conducted in Kedah and the evidence of the effectiveness that intervention program remains limited. A review on strategies intended to address vaccine hesitancy showed that the meta-analysis of 15 published literature reviews was no strong evidence of efficacy for any specific intervention (Dubé *et al.,* 2015). In addition, interventions that are against anti-vaccine groups may be unsustainable, ineffective, and potentially more harmful than no intervention at all (Betsch *et al.,* 2015; Betsch & Böhm, 2016; Dubé *et al.,* 2015).

Four factors that cause vaccine hesitancy, which is a lack of understanding regarding the risk of the vaccine and the vaccine itself, having experience with vaccines, involving religious or political issues, and socioeconomic status (Anthony Appiah, 2021; Larson *et al.,* 2011). The main cause of vaccine hesitancy does not necessarily involve individual-level issues such as knowledge and awareness, it also needs more attention at the community and social network level (Jarrett *et al.,* 2015). This research focuses on current vaccine sentiment and differing vaccine sentiment among the general public at the community and social network level from Facebook pages.

Sentiment analysis is a computational study that has been conducted as a Natural Language Processing (NLP) that analyzes the people's sentiment, opinion, appraisal, evaluation, emotions, and attitudes regarding service, product, individual, organization, politic, topic, issue or their attributes (Ainin *et al.,* 2020; Bakar *et al.,* 2020; Budiharto & Meiliana, 2018; Kabir *et al.,* 2020; Poecze *et al.,* 2019). Usually, most researchers use the term sentiment analysis (Nasukawa & Yi, 2003) the original term is opinion mining (Dave *et al.,* 2003). In the medical field, sentiment analysis was used to examine current vaccine sentiment on social media (Kang, Ewing-Nelson, *et al.,* 2017; Klimiuk *et al.,* 2021; Lyu *et al.,* 2021, p.; On *et al.,* 2019; Piedrahita-Valdés *et al.,* 2021). It also was beneficial for public health to communicate closely with the community at the community and social network level, like Facebook pages.

Semantic network analysis is a graphical study that represents knowledge of relationships between words or written text that is structured as a network (Drieger, 2013; Eklund & Haemmerlé, 2008; Gloor & Diesner, 2014). Semantic network analysis consists of two terms that are nodes and edges. Nodes represent words that can be found in comments or text, classes of things, individuals, instances, or objects. While edges represent the connections or relationships between nodes. Semantic network analysis can extract meaningful ideas in terms of identifying emerging clusters in the form of a graph rather than analyzing the frequency of words itself (Doerfel, 1998). Based on previous studies, semantic network analysis was also closely related to Big Data and most researchers use the term Big Data in their title of the study (Ban & Kim, 2019; H.-S. Kim, 2017). In addition, semantic network analysis also was used regarding financial markets, fashion design trends, emergency management, political issues, service, and experience (An & Park, 2020; Colladon *et al.,* 2020; Eddington, 2020; M. Kim *et al.,* 2017; Liu *et al.,* 2018; Oh & Kim, 2020; Xiong *et al.,* 2019). In the medical field, semantic network analysis was used to examine vaccine hesitancy in online social media (DeDominicis *et al.,* 2020;Ruiz, et al., 2020; Kang, Ewing-Nelson, *et al.,* 2017; Ruiz *et al.,* 2021; Wang *et al.,* 2020) and also used to understand the user experiences of mental disorders (Han *et al.,* 2017; Yoo *et al.,* 2019). With semantic network analysis, analyzing the current vaccine sentiment from Facebook pages related to the vaccination program can enhance understanding of complex health behavior, particularly for vaccine hesitancy.

Despite the efforts by MOH to strengthen the existing strategies and maximize the vaccination coverage, especially in urban areas, children vaccination refusal cases are still occurring. Two main

problems have been identified in this research that causes the occurrence of children vaccination refusal cases in Malaysia.

Firstly, there has been reported that parents always received wrong information about vaccination programs from unverified sources, especially on social media platforms (Himelboim *et al.*, 2020; Kang, *et al.*, 2017). They tend to believe what has been written and posted on social media instead of information from reliable sources like medical practitioners. The fact is a survey study conducted in Germany shows that 95.0% of participants agreed that the most reliable source to get information regarding children's vaccination is a pediatrician (Heininger, 2006).

Secondly, this problem has negatively impacted parents who are not up to date (e.g.: lower knowledge and practices on children vaccination), compared to those parents who are up to date (Awadh *et al.*, 2014). According to Awadh *et al* (2014), a possible cause of this problem is the education and counseling program are not well routed among parents who refused the vaccination in Malaysia. Furthermore, there is a limited extensive study on factors and reasons for these parents who refused and return to the vaccination program. To date, the existing qualitative studies worldwide mainly explore the understanding of children's vaccination (Sobo, 2015; Tombs-Heirman, 2009), sources from which parents receive the information on vaccination (Leask *et al.*, 2006), reasons for the children's vaccination refusal (Gross *et al.*, 2015; Harmsen *et al.*, 2013; Rumetta *et al.*, 2020) and recommendations for children vaccination among parents who refused vaccination (Rumetta *et al.*, 2020). The previous study has found an interesting finding whereby the number of parents who refused their children's vaccination decreased and return to accept the vaccination after the intervention (Chan *et al.*, 2018). There is an urge to understand the pattern or combination of words that has arisen in the children's vaccination that can represent the negative, positive and neutral sentiment among parents (Callaghan *et al.*, 2019).

Recently, a qualitative study is conducted by Rumetta *et al* (2020) in Malaysia on reasons and recommendations for children vaccination among parents who do not vaccinate their children with any type of vaccination. However, the study is conducted among parents in Klang Valley only, which is an urban area. Besides, due to the small number of samples, the study is not generalized to the whole population itself.

Hence, due to these gaps, this current study is aimed to examine current vaccine sentiment from Facebook pages related to the vaccination program and analyze the semantic network of vaccine sentiment. This research can be essential for MOH, as it has a great opportunity to maximize the vaccination coverage.

METHODOLOGY

This research employed the approaches of quantitative and qualitative which are addressed to sentiment analysis and semantic network analysis, respectively, commonly known as a mixed-method approach. The mixed-method approach type of analysis adopted in this research is semantic social networks (SSN), which are used to digitalize and visualize the ethnographic data, whether it is the online conversation format or social interaction where the codes are made by researchers in network form (Cottica *et al.*, 2020). Firstly, a quantitative approach was conducted by using sentiment analysis based on the number of negative, positive, and neutral words regarding the vaccination program from the Facebook pages related to the vaccination program. Secondly, a qualitative approach uses semantic network analysis for analysing the vaccine sentiment.

Sentiment Analysis

The data analyses were performed using RStudio software version 4.1.0 (Allaire, 2012). Recently, R software has provided many free packages to quickly calculate the sentiment of textual contents at the sentence level and deliberately cumulate by grouping or row variables such as *sentimentr* and *Sentiment Analysis* (Kao & Poteet, 2007). Usually, the Open Authorization (OAuth) package of R language was used to access social media such as Facebook via APIs (Ravindran & Garg, 2015). First, an account on Facebook API was generated and linked to the Facebook account. Second, the Facebook API

Authentication process was executed in *Facepager* software version 4.3 (Jünger & Keyling, 2019). The data was extracted raw from the well-known social media networking site in Malaysia – Facebook. The search strategy keywords applied, which refer to the words used in Facebook comments are *tolak vaksin malaysia*, *tolak imunisasi malaysia*, *terima vaksin malaysia*, *terima imunisasi malaysia*, *penolakan vaksin malaysia*, *penolakan imunisasi malaysia*, *penerimaan vaksin malaysia* and *penerimaan imunisasi Malaysia*. A total of 7,107 comments were collected between 01 December 2020 to 31 December 2020.

Third, the raw data were screened to remove the unnecessary data such as emoticons, punctuations '@', symbols, numbers, special characters, spaces, or stopwords such as 'yang', 'di', 'pada', and so on. The duplicate comments on a Facebook page were also have been removed in this step (Al-Saffar et al., 2018) as well as any comment on a Facebook page that contained "www" or "https://", "@username", "URL", and "AT_USER" were removed (Ibrahim & Yusoff, 2015). Then lastly, the data was converted from uppercase to lowercase so that the data keep important information only for the next analysis (Rashid *et al.*, 2013).

Sentiment analysis was used to analyze the sentiment, emotion, attitude, people's opinion, evaluation, and appraisal toward some entities such as topics, events, issues, products, service, individual, organization, or their attributes (Budiharto & Meiliana, 2018). Generally, the sentiment analysis was generated to set up or search a list of words in the SentiLexM, which is a sentiment lexicon for the Malay language built using multiple sources of information such as AFINN-111 (Nielsen, 2017) and *Kamus Dewan Inggeris Melayu – An English-Malay Dictionary* (Bakar *et al.*, 2020; Tan *et al.*, 2016). The lexicon is constituted of around 26,004 polarized words with more specific 2,477 for English words and 23,527 for Malay words, classified by their morphological category annotated with polarities positive, negative, and neutral. In constructing a classifier model, the pre-processed data was scored and grouped into two groups that are positive and negative by using the *Syuzhet* package. The sentiment score was calculated using the score formula below:

$$Sentiment\ score = N_{positive} - N_{negative}$$

The Npositive is denoted as the number of positive words, while Nnegative is denoted as the number of negative words. The sentiment score for each sentence is categorized into:

1. Sentiment score of more than 0 is considered to be an overall positive opinion.
2. A sentiment score of less than 0 is considered to be an overall negative opinion and,
3. A sentiment score equal to 0 is considered to be a neutral opinion.

Semantic Network Analysis

The semantic network analysis was used for the selected network metrics, which serves the purpose to reduce bias in the interpretation (Thovex & Trichet, 2013). Besides, semantic network analysis is also described as a process of analyzing the semantic network structure among nodes or agents (Drieger, 2013). The positive and negative sentiment networks analysis was concentrated on the best-connected component or subgraph. There are four most common centrality measures (Nieminen, 1973; Shaw, 1954), which are the degree of betweenness (Freeman, 1977), and closeness (Beauchamp, 1965; Sabidussi, 1966), and eigenvector (Bonacich, 1972). In a centrality degree, the centrality is denoted as *CD*, which measures the number of links upon a node. In betweenness centrality, the centrality is denoted as *CB*, which is a measure of the shortest paths between the other two nodes in the network. In closeness centrality, the centrality is denoted as *CC*, which measures how fast the information from a given node to every other node in the network. Finally, the eigenvector centrality, which is denoted as *CE*, measures the importance of a node to its neighbors. The *WORDij* software (Danowski, 2013) was used to construct and analyze the network, while visualizations were created in *Gephi* software version 0.9.2 (Bastian *et al.*, 2009).

RESULTS AND DISCUSSION

Out of 5,055 comments, the majority of the comments are negative sentiment (49.33%), followed by positive (32.58%) and neutral (18.08%) sentiment.

Sentiment Analysis

Overall, out of 19,974 words, Table 1 showed that the most frequent words used were *tolak* (9.71%) and *vaksin* (8.25%) where both words express more the negative sentiment, which represents 91.59%

and 48.76% of all words, respectively, followed by *terima* (3.90%), which express more towards the positive sentiment (79.82%). Words listed in Table 1 can also be presented in a graphic format. The Wordcloud can show the most popular words graphically and it is a quick way to summarize the content of comments on a Facebook page. In the Wordcloud, the more often the word is used, the bigger the word appears. As can be seen in Figure 1, *tolak* is the most used word in this study, followed by *terima*, *tidak*, *setuju* dan *selamat*. This result is supported by another study regarding the COVID-19 vaccine on Twitter (Lyu *et al.*, 2021) which is the most tweeted topic was opinions about vaccination that is 15.2%. According to Lyu *et al.*, (2021), out of 1,499,421 tweets posted on Twitter, the highest percentage of the topic are opinions about vaccination, which contribute 15.2% of all words studied. The words that contributed to this topic are *people*, *get*, *take*, *go*, *want*, *make*, *like* and *think*. In addition, other topics are almost similar to this study, which is related to the function of vaccines (5.43%). The words that contributed to this topic are people, effect, test, risk, side, immune, and death.

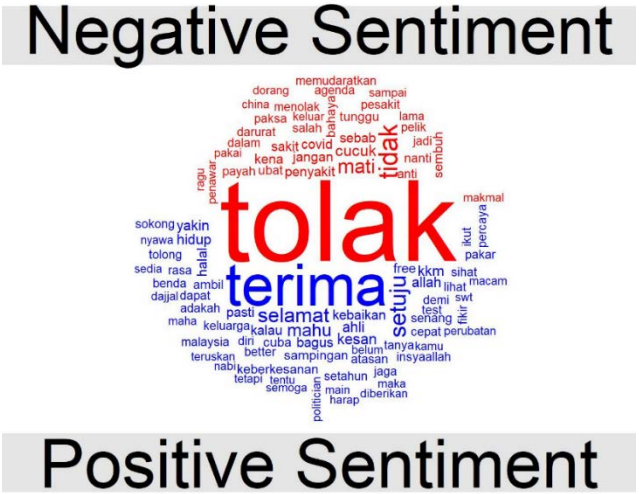

Figure 1: Wordcloud for the vaccination program

Table 1: Top 20 Words by Sentiment

	Negative Sentiment		Positive Sentiment		Neutral Sentiment		Total	
Words	***n***	**(%)**	***n***	**(%)**	***n***	**(%)**	***n***	**(%)**
Tolak	1,776	(91.59)	111	(5.72)	52	(2.68)	1,939	(9.71)
Vaksin	803	(48.76)	583	(35.40)	261	(15.85)	1,647	(8.25)
Terima	94	(12.08)	621	(79.82)		(8.10)	778	(3.90)
Tidak	450	(64.56)	155	(22.24)	92	(13.20)	697	(3.49)
Mahu	214	(43.50)	231	(46.95)	47	(9.55)	492	(2.46)
Kalau	174	(45.55)	155	(40.58)	53	(13.87)	382	(1.91)
Covid	178	(54.60)	103	(31.60)	45	(13.80)	326	(1.63)
Buat	124	(44.60)	95	(34.17)	59	(21.22)	278	(1.39)
Sudah	133	(48.01)	94	(33.94)	50	(18.05)	277	(1.39)
Kena	109	(53.17)	54	(26.34)	42	(20.49)	205	(1.03)
Test	66	(32.35)	61	(29.90)	77	(37.75)	204	(1.02)
Sebab	120	(60.91)	56	(28.43)	21	(10.66)	197	(0.99)
Setuju	24	(12.57)	159	(83.25)	8	(4.19)	191	(0.96)
Kkm	70	(37.84)	86	(46.49)	29	(15.68)	185	(0.93)
Suntik	69	(40.35)	48	(28.07)	54	(31.58)	171	(0.86)
Mati	150	(94.94)	7	(4.43)	1	(0.63)	158	(0.79)
Cucuk	111	(71.15)	29	(18.59)	16	(10.26)	156	(0.78)
Jangan	93	(60.00)	43	(27.74)	19	(12.26)	155	(0.78)
Selamat	24	(15.69)	123	(80.39)	6	(3.92)	153	(0.77)
Ahli	39	(26.90)	69	(47.59)	37	(25.52)	145	(0.73)

Table 2: Expression of Words for vaccination program

Words	Overall			
	Degree centrality	**Betweenness centrality**	**Closeness centrality**	**Eigenvector centrality**
Vaksin	1.00	1.00	0.81	1.00
Tolak	0.78	0.25	0.59	0.72
Side	0.73	0.00	0.46	0.18
Terima	0.73	0.12	0.56	0.63
Suntik	0.67	0.01	0.50	0.34
Kesan	0.60	0.03	0.50	0.37
Halal	0.60	0.00	0.48	0.20
Ubat	0.56	0.01	0.49	0.23
Mati	0.53	0.01	0.51	0.33
Cucuk	0.53	0.01	0.50	0.38
Sunnah	0.51	0.01	0.47	0.11
Selamat	0.51	0.01	0.50	0.33
Keberkesanan	0.51	0.00	0.48	0.23
Kkm	0.49	0.01	0.49	0.31
Ahli	0.44	0.03	0.50	0.31
Berkesan	0.44	0.00	0.48	0.23
Harus	0.42	0.00	0.47	0.16
Allah	0.40	0.05	0.50	0.20
Mendesak	0.38	0.00	0.00	0.00
Ulama	0.33	0.00	0.00	0.00
Mampu	0.31	0.00	0.45	0.08
Berpegang	0.29	0.00	0.00	0.00
Keburukan	0.29	0.00	0.00	0.01
Penyakit	0.29	0.02	0.49	0.16
Source	0.24	0.00	0.45	0.00
Immune	0.24	0.00	1.00	0.00

Table 3: Expression of Words for negative sentiment regarding vaccination program

Words	Negative vaccine sentiment network			
	Degree centrality	**Betweenness centrality**	**Closeness centrality**	**Eigenvector centrality**
Vaksin	1.00	1.00	0.81	1.00
Semulajadi	0.78	0.25	0.59	0.72
Kerajaan	0.73	0.12	0.56	0.63
Ahli	0.67	0.01	0.50	0.34
Kesan	0.60	0.03	0.50	0.37
Tolak	0.60	0.00	0.48	0.20
Enggan	0.56	0.01	0.49	0.23
Jururawat	0.53	0.01	0.51	0.33
Memerlukan	0.53	0.01	0.50	0.38
Barat	0.51	0.01	0.50	0.33
Cara	0.49	0.01	0.49	0.31
Organisasi	0.44	0.03	0.50	0.31
Sihat	0.44	0.00	0.48	0.23
Quran	0.40	0.05	0.50	0.20
Cucuk	0.31	0.00	0.45	0.08
Yahudi	0.29	0.02	0.49	0.16
Mati	0.24	0.00	0.45	0.00

Table 4: Expression of Words for positive sentiment regarding vaccination program

Words	Positive vaccine sentiment network			
	Degree centrality	Betweenness centrality	Closeness centrality	Eigenvector centrality
Dajjal	1.00	1.00	0.81	1.00
Lab	0.78	0.25	0.59	0.72
Vaksin	0.73	0.00	0.46	0.18
Fda	0.73	0.12	0.56	0.63
Agama	0.67	0.01	0.50	0.34
Neraka	0.60	0.03	0.50	0.37
Mufti	0.60	0.00	0.48	0.20
Pasti	0.56	0.01	0.49	0.23
Nabi	0.53	0.01	0.51	0.33
Memerlukan	0.53	0.01	0.50	0.38
Terima	0.51	0.01	0.47	0.11
Barat	0.51	0.01	0.50	0.33
Suntik	0.51	0.00	0.48	0.23
Check	0.49	0.01	0.49	0.31
Dibawa	0.44	0.03	0.50	0.31
Mati	0.44	0.00	0.48	0.23
Halal	0.42	0.00	0.47	0.16
Sembuh	0.40	0.05	0.50	0.20
Selamat	0.38	0.00	0.00	0.00
Kkm	0.33	0.00	0.00	0.00
Makmal	0.31	0.00	0.45	0.08
Tolak	0.29	0.00	0.00	0.00
Kesan	0.29	0.00	0.00	0.01
Terlibat	0.29	0.02	0.49	0.16
Hadis	0.24	0.00	0.45	0.00
Kuat	0.24	0.00	1.00	0.00

Semantic Network Analysis

Table 2 presents the outcome of the Overall Sentiment for Words from the Semantic Network Analysis. From this table, *vaksin*, *tolak* and *terima* have the highest degree (CD), betweenness (CB), closeness (CC) and eigenvector centrality (CE) with the values of CD=1.00; CB=1.00; CC=0.81; CE=1.00, CD=0.78; CB=0.25; CC=0.59; CE=0.72 and CD=0.73; CB=0.12; CC=0.56; CE=0.63, respectively. These three words show the existence of very high connectivity, very importance in information flow, very easy access to all nodes, and very high neighbor connectivity in the analysis. The Negative Sentiment analysis is presented in Table 3 and the explanation of the findings is as follows. Only three words scored a highest degree, betweenness, closeness and eigenvector centrality, which are *vaksin* (CD=1.00, CB=1.00, CC=0.81, CE=1.00), *semulajadi* (CD=0.78, CB=0.25, CC=0.59, CE=0.72) and *kerajaan* (CD=0.73, CB=0.12, CC=0.56, CE=0.63). Meanwhile, for the Positive Sentiment, similar to the Overall Sentiment analysis, three words have been determined to score the highest based on the values of degree, betweenness, closeness, and eigenvector centrality, as shown in Table 4. The three words are *dajjal* (CD=1.00, CB=1.00, CC=0.81, CE=1.00), *lab* (CD=0.78, CB=0.25, CC=0.59, CE=0.72) and *FDA* (CD=0.73, CB=0.12, CC=0.56, CE=0.63). Figure 2 provides a semantic network view of the connectivity between these words. This semantic network view is also helpful in visualizing how the various words are related. Overall, the word *vaksin* which has a high centrality value was directly connected to the words *tolak*, *terima*, *cucuk*, *suntik*, *mati*, and *kesan* indicating that accept vaccination if no side effects, however, most of them reject vaccination mainly due to side effects that can lead to death. For the negative sentiment, the word *vaksin* which has a high centrality value was directly connected to the words *semulajadi*, *kerajaan*, and *tolak* indicating that rejection of vaccination is mainly recommended to the government to use nature as the main ingredient in producing vaccines. For the positive sentiment, the word *dajjal* which has a high centrality value was directly connected to the words *lab* and *FDA* indicating that believing that these vaccines have a specific agenda

that is closely related to the Food and Drug Administration (FDA). This result is supported by Kang *et al* (2017) regarding vaccine sentiment in online social media. According to Kang *et al* (2017), *vaccines* and *vaccination* were the most central nodes and centrality measures for the negative sentiment, neutral sentiment, and positive sentiment.

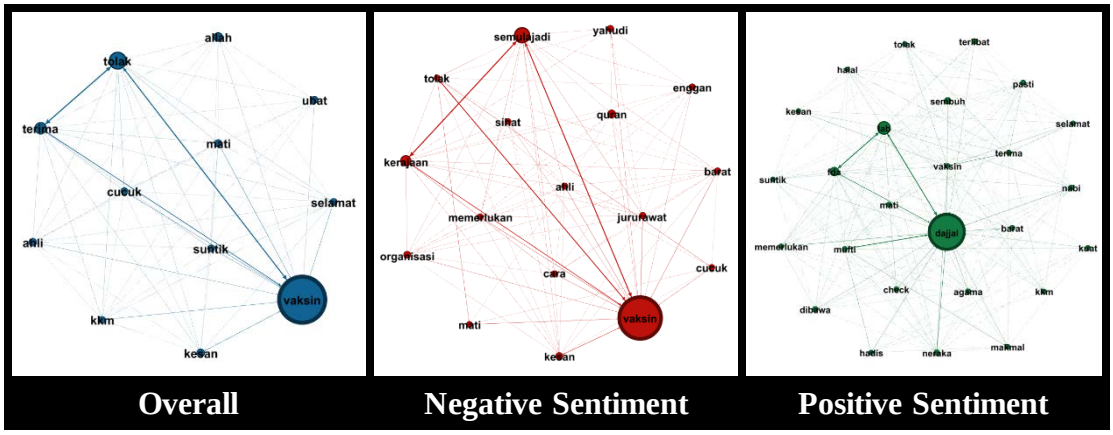

Figure 2: Semantic Network Analysis for the Words by Overall, Negative and Positive Sentiment

CONCLUSION

Findings from this research contributed to two new discoveries. In terms of the methodology of research, this is the first study that has been conducted in Malaysia whereas most of the previous studies were handled in the United States, Poland, Spain, and the Republic of Korea. Hence, this research finding enriched the body of knowledge in terms of cross-sectional research design. From a practical perspective, by understanding parents' behavior and opinion about children's vaccinations on social media, this research is beneficial for practitioners, especially the Malaysia Ministry of Health (MOH). It can assist the MOH, specifically the public health communication department to identify important keywords that are usually being used by the public in order to study the parents' sentiment on the vaccination program. The keywords determined in this research can be used to study the vaccine hesitancy issues, such as vaccination campaigns or consultations on social media in the MOH strategies of the vaccination program.

Conflict of Interest

The authors declare that they have no competing interests in writing this article.

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