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The impact of the basic dose of the COVID-19 vaccine and the number of COVID-19 patients on Google searches for vaccines

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ABSTRACT

Indonesia has distributed the COVID-19 vaccinations to its people starting from January 2021 based on certain priorities to deal with COVID-19 pandemic. News of deaths after the COVID-19 vaccination has made some people hesitate to get vaccinated. This study aims to depict the pattern and determinant of public interest in COVID-19 vaccine information using Google Trends data. The pattern can be used as a suggestion to the government to conduct a campaign on the COVID-19 vaccine. Several topics related to the COVID-19 vaccine were collected from Google Trends and then clustered by the province using K-Means. By total within sum of square, best number of clusters is two. Then, a logistic regression analysis was done with cluster as response variable to find out what factors made people interested in the COVID-19 vaccine topic. As a result, percentage of people who received the first dose of the COVID-19 vaccine and the rate of COVID-19 patients who were treated had influenced public interest in the COVID-19 vaccine. Hence, the campaign must be transparent so that the public can see both the good and bad effects of vaccination. It will help to reduce the number of people dying after receiving vaccinations.

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1. INTRODUCTION

Indonesia has distributed five different types of COVID-19 vaccine, namely Sinofarm, Sinovac, Astrazeneca, Modena, and Pfizer. However, the COVID-19 vaccine has been reported to have some side effects [1], [2]. The side effects that arise are different for each recipient of the COVID-19 vaccine. Some of the mild and short-term side effects include fever, fatigue, headache, muscle aches, chills, diarrhea, and pain at the injection site.

The side effect of the COVID-19 vaccine is one of the factors why people are hesitant to get the COVID-19 vaccine in addition to other reasons such as the effectiveness of the vaccine itself and the safety of the vaccine [3]–[6]. Doubts also occur among health workers [7]. Moreover, there are some negative rumors in 52 countries about vaccines from various sources including Google, Facebook, television, etc that make people reluctant to get them [8]. Another factor that makes people reluctant to receive the COVID-19 vaccine is the lack of information about the vaccine itself, the education level of the respondents, and the gender of the respondents [3], [9]–[12]. Nevertheless, factors that discourage people from being vaccinated need to be minimized by targeted campaign so that the vaccination program runs smoothly during the vaccination period.

Google Trends has been widely used to measure people's interest in certain issues [13], [14]. In previous research, Google Trends was used to predict a particular event or analyze the impact of an event, especially in the field of health on public interest in a particular issue [15]–[19]. In case of COVID-19, Google Trends has been utilized to monitor public interest related COVID-19, COVID-19 vaccine, and COVID-19 vaccine misinformation topic. So, it can be used as a reference in conducting campaigns to increase public knowledge about COVID-19 [20]–[24]. Public interest in the topic of COVID-19 increased when COVID-19-related events occurred such as the first COVID-19 infection and the first injection of COVID-19 vaccine. Other variables also have affected the interest increase, such as the COVID-19 infection rate [23].

The purpose of this study is to investigate the public's interest in information about the COVID-19 vaccine and the factors that are associated with it to determine vaccine campaign strategy for targeted people. The platform used to analyze the public interest is Google Trends. This research takes the space to cluster provinces using Google Trends based on public interest and uses the cluster to look for other factors that influence public interest in the COVID-19 vaccine besides infection rates of COVID-19. Clustering is used for the purpose of determining the right campaign strategy for each cluster based on their characteristics.

2. RESEARCH METHOD

2.1. Data

This study used two main data sets for analysis. The first data used in this study comes from https://trends.google.co.id/, Statistics Indonesia, and Ministry of Health. Google Trends data collected in the following topic "coronavirus", "AstraZeneca", "COVID 19 vaccine", and "Sinovac Biotech" between November 15, 2020 to June 30, 2021. Interest data over time is an index created by Google Trends, which can be used to compare the search popularity of a keyword in an area [25]. The topic is used because the topic is a compilation of various keywords. The data taken is worth 0 to 100. The number 100 shows the highest interest from the period. Interest data by subregion is also taken to compare public interest in each province. Interest data by region shows 100 for the region with the highest search interest compared to other regions. The higher the value means the higher the proportion of a query compared to other queries [25]. To find out the determinants that influence people's interest in topics related to the COVID-19 vaccine, this study used variables on Table 1.

Table 1. Determinant of public interest on COVID-19 vaccines topic

Variable	Description	Data Type	Source	Reference
Percentage of population who have received dose 1 of COVID-19 vaccine	Percentage of total population who have received doses 1 COVID-19 vaccine per total population in province on June 30th, 2021	numerical	https://covid19.bps.go.id	-
Percentage of population who have received dose 2 of COVID-19 vaccine	Percentage of total population who have received doses 2 COVID-19 vaccine per total population in province on June 30th, 2021	numerical	https://covid19.bps.go.id	-
COVID-19 cases percentage	Total COVID-19 cases per total population in province on June 30th, 2021	numerical	https://covid19.bps.go.id	-
Percentage of COVID-19 cases under treatment	Total COVID-19 cases which under treatment per total COVID-19 cases on June 30th, 2021	numerical	https://covid19.bps.go.id	-
COVID-19 recovery rate	Total recovered cases per total COVID-19 cases on June 30th, 2021	numerical	https://covid19.bps.go.id	-
COVID-19 mortality rate	Total death cases per total COVID-19 cases on June 30th, 2021	numerical	https://covid19.bps.go.id	-
Average Years of Schooling	The average number of years of education a student has actually received	numerical	https://bps.go.id	[26]
Number of public health center	Number of first-level health care facilities that carry out individual health efforts	numerical	https://pusdatin.kemkes.go.id/	[27]

2.2. K-Means

Clustering on the k-means algorithm is done by minimizing the sum of squares from the cluster [28], [29]. The k-means algorithm requires the number of clusters. Determination of the number of clusters is conducted by looking at the total within sum of square. The calculation of total within sum of square is done by the following formula (1):

$$Total\ within\ sum\ of\ square = \sum_{j=1}^{k}\sum_{i=1}^{n}(x_{ij} - \bar{x}_j)^2 \quad (1)$$

Note:
x_{ij} : the value of the i-th observation in the j-th cluster
$\bar{x}_j$: the centroid of the j-th cluster

In this study, k-means was used to create the dependent variable in finding the determinants of public interest in searching for topics related to the COVID-19 vaccine.

2.3. Chi-square test

The Chi-square test is one of the non-parametric methods used to see associations between variables. The Chi-square test does not require assumptions to do so [30], [31]. This study used Chi-square to look at the variables that affected respondents who claimed to experience side effects from the COVID-19 vaccine.

2.4. Binary logistics regression and odd ratio

Binary Logistic regression is a data analysis method for response variables of categorical type with 2 category [32], [33]. In binary logistic regression, the success event is denoted by Y=1 and the failure event is denoted by Y=0.

Odd ratio is a measure to express the tendency of the independent variable to the dependent variable. The odd ratio value states the tendency of the results that arise as a result of certain treatments [34], [35]. The odd ratio formula is written as (2):

$$OR = \frac{cumulative\ incidence\ of\ exposed\ group}{cumulative\ incidence\ of\ unexposed\ group} \quad (2)$$

2.5. Framework

Based on the background, this research seeks to find patterns of public interest in the COVID-19 vaccine from google trends data. Public interest data is used as the basis for making provincial clusters to group each province with similar characteristics. Furthermore, an analysis of the variables that influence the public's interest in finding information related to the COVID-19 vaccine is carried out based on the province cluster. A diagram of this research framework is depicted in Figure 1.

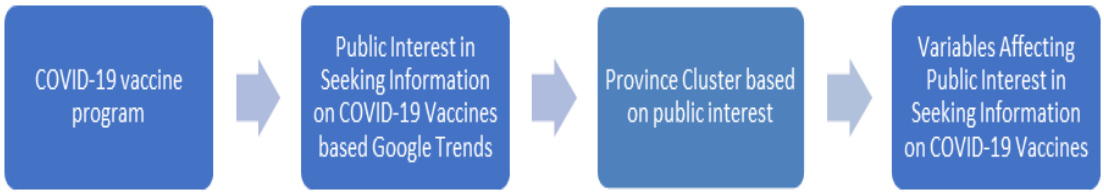

Figure 1. Research framework

3. RESULT AND DISCUSSION

3.1. COVID-19 vaccine search trends

Based on Figure 2, search volume on the topics of Coronavirus, Astrazeneza, COVID-19 Vaccine, and Sinovac Biotech seem to have an increasing trend at certain times. The topic of coronavirus tends to be stable and has increased several times on April 6, 2021, May 1, 2021, and May 12-13, 2021. The increase in the trend of searching for the topic of coronavirus occurs due to restrictions on access between regions to prevent the homecoming culture that occurs every Eid Al-Fitr, hoping that the rate of transmission of COVID-19 will not increase.

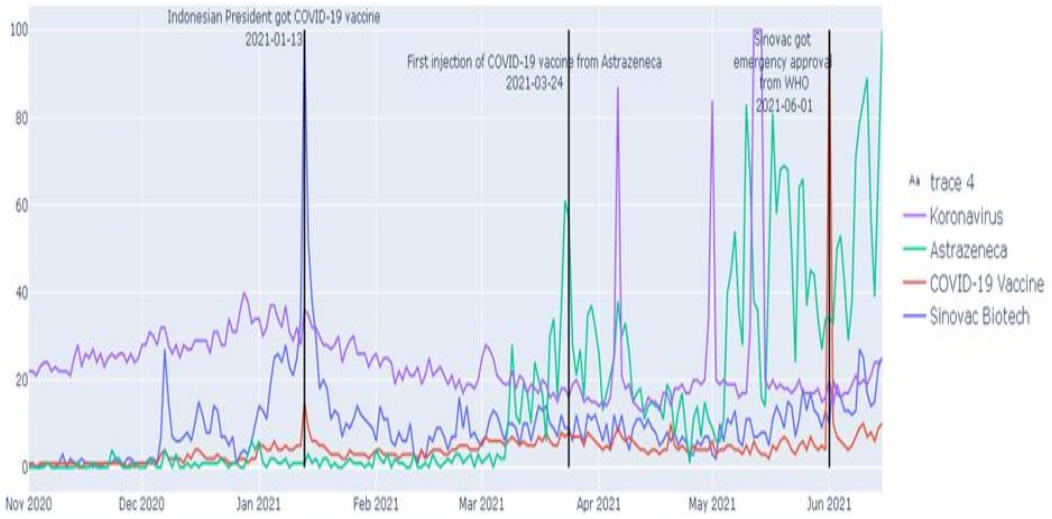

Figure 2. Search trends for COVID-19 vaccine topic

The search for the topic of Sinovac Biotech began to increase in early December 2020 since the news that the Indonesian government would use a vaccine from Sinovac and the peak of the search trend occurred on January 13, 2021, coinciding with the injection of the first vaccine in Indonesia to the President of Indonesia. Searches related to the AstraZeneca topic began to increase in March 2021 due to news of the AstraZeneca vaccine arriving in Indonesia. Finally, searches related to the COVID-19 Vaccine showed the highest increase in searches that occurred on June 1, 2021. On that date, there was news from WHO that issued a permit for vaccines of Sinovac to be used.

Observing the trend of public interest regarding the COVID-19 vaccine, events related to the topic of the COVID-19 and COVID-19 vaccines are thought to increase public interest in finding information about the COVID-19 vaccine topic through the Google. This can be seen from the increase in searches related to the topic of Sinovac Biotech on January 13, 2021, when the president of Indonesia, Joko Widodo, received the 1st dose of the vaccine. The increase in searches related to the topic of Astrazeneca also increased after the injection of the first AstraZeneca vaccine. The topic of COVID-19 vaccines also increased when Sinovac received recommendations from WHO. This increase is positive because people's curiosity about the COVID-19 vaccine is rising. Like previous research, Google Trends can describe the public's response to particular news [14] and news about COVID-19 influencing public interest about COVID-19 depicted by Google Trends [20], [22].

Table 2. Top 10 province with high interest for topics related to the COVID-19 vaccine

Province	Topic			Topic interest average
	AstraZeneca	Vaksin COVID-19	Sinovac Biotech	
Riau Islands	100	88	100	96.00
DKI Jakarta	88	83	87	86.00
Bali	83	100	46	76.33
Di Yogyakarta	65	66	49	60.00
Banten	51	74	65	63.33
North Sulawesi	58	49	65	57.33
East Java	30	57	40	42.33
West Kalimantan	24	46	44	38.00
West Java	24	53	36	37.67
East Nusa Tenggara	19	42	31	30.70

If we look at the public's interest in information related to the COVID-19 vaccine, there are differences at the provincial level as shown in Table 2. There are provinces with low interest and there are high ones. Provinces with a high interest in information related to the COVID-19 vaccine include the provinces like Riau Islands, DKI Jakarta, and Bali. Meanwhile, provinces with low interest in information related to the COVID-19 vaccine are Gorontalo, West Sulawesi, and North Kalimantan

3.2. COVID-19 vaccine search cluster

From the interest of the people per province, a cluster was created with the variables of interest in the public's search for the topics of AstraZeneca, COVID-19 Vaccine, and Sinovac Biotech. The results of this cluster are used as the dependent variable to find the determinants of public interest in topics related to the COVID-19 vaccine. Clusters were created using the K-means method. Figure 3 shows the optimal cluster to divide provinces based on the search volume is 2 seen from the Total Within Sum of Square graph. Cluster chosen as the basis for cluster formation is 2 because an increase in the number of clusters can be carried out as long as the estimation error decreases significantly [36].

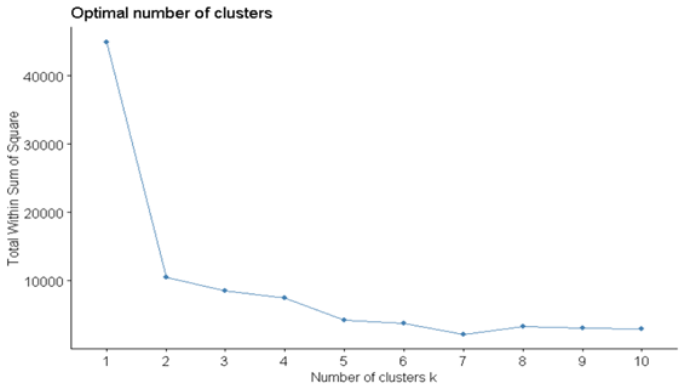

Figure 3. Total within sum of square

From the cluster centroid shown in Table 3, it can be seen that cluster 1 has a higher search volume across all topics than cluster 2. The rest are in cluster 2. The number of provinces in cluster 1 is five provinces, including DKI Jakarta, DI Yogyakarta, Riau Islands, Banten, and North Sulawesi. Other provinces are in cluster 2 as in Figure 4.

Table 3. Clusters of topic search related to COVID-19 vaccine

Cluster	AstraZeneca Topic	COVID-19 Vaccine Topic	Sinovac Biotech Topic
1	74.17	76.67	68.67
2	13.64	41.29	23.46

Figure 4. Cluster of COVID-19 vaccine topic search per province

Riau Islands, DKI Jakarta, DI Yogyakarta, and North Sulawesi are included in the top 5 largest percentage of receiving COVID-19 vaccine dose 1 in Indonesia. Based on cluster, Banten is in cluster 1, however, the percentage of receiving COVID-19 vaccine dose 1 is still low, in contrast to Bali, which received the highest dose of COVID-19 vaccine in Indonesia despite being in cluster 2. It indicates that percentage of receiving COVID-19 could be one of the determinants of people searching for information about COVID-19.

3.3. Determinants of interest in searching for a COVID-19 vaccine

To find out the variables that affect the search for topics related to the COVID-19 vaccine in all provinces, we used logistic regression with the response variables is province cluster that have been formed. Cluster 1 as a succeed condition on this model. The selection of variables used a two-way stepwise method using Akaike's information criterion (AIC) as the evaluation value. The variables included all variable that have been mentioned in Table 1. The best model formed is shown in Table 4 with an AIC value of 0.52612.

Table 4. Variables that influence the proportion of topics searched for COVID-19 vaccines

Model	β	Exp(β)	p-value
(Intercept)	-0.44	0.64	0.00
Percentage of Dose 1	2.12	8.29	0.00 *
Percentage of COVID-19 patients in treatment	1.12	3.07	0.02 *

Note : significant to $\alpha = 5\%$

Based on the model, the influencing variables are the percentage of the population who have received dose 1 of the COVID-19 vaccine and the percentage of COVID-19 patients in treatment. Based on this model, it can be concluded that a one percent increase in the population that has received dose 1 of the COVID-19 vaccine will result in an 8.2896-fold increase in search volume. Then, a one percent increase in COVID-19 patients who are still being treated will result in a 3.0707-fold increase in search volume.

From the result, we can conclude that people start to seek information regarding the COVID-19 vaccine after more people have received the vaccine in their neighborhood and when there is an increase in patients being treated. This shows that in addition to public announcements about vaccines, neighborhood conditions in the community also influence people's willingness to seek information about the COVID-19 vaccine. This is in line with other studies that state that environmental conditions such as the vulnerability of an area exposed to COVID-19 can affect people's knowledge and desire to be vaccinated [4], [37]. As previous research, infected number of COVID-19 influence public interest on COVID-19 topic [23]. This can be a concern for the government in conducting a campaign for the COVID-19 vaccine so that before receiving the vaccine, the public already knows the requirements for getting the vaccine until the post-vaccine handling. The campaign can be carried out with targeted campaigns for certain population groups need due to differences in knowledge and characteristics of certain population [38]. Besides, the campaign for the COVID-19 vaccine can be focused on areas where there are still few people who receive the COVID-19 vaccine. Transparent campaigns can be carried out by building public trust in vaccines, providing vaccine-related facts, providing clear information about the benefits and risks of receiving vaccines, using visual aids, and testing outreach tools before going into the field [39], [40].

4. CONCLUSION

This study has shown that every event related to the COVID-19 vaccine will increase the trend of searching for topics related to the COVID-19 vaccine. This could indicate the public's curiosity about the COVID-19 vaccine. Public interest related to COVID-19 vaccine depends on the variables of the percentage of the population who received dose 1 of the COVID-19 vaccine and the percentage of COVID-19 patients who are still being treated. This could show that people tend to seek information related to vaccines when a lot of people in their environment have received the COVID-19 vaccine. Moreover, the results of this study could be used for consideration in the implementation of campaigns to the public regarding COVID-19 vaccine information. The campaign needs to look at the clusters of public interest in the COVID-19 vaccine topic and be carried out transparently so that people in cluster 2 areas have sufficient information about the COVID-19 vaccine. Delivering a campaign by looking at the characteristics of the target group can also be executed to increase public awareness regarding the COVID-19 vaccine.

The drawback of this approach is the lack of representation from all community groups, especially people who do not have access to internet. The absence of information about the method used by Google Trends in forming an index of Google users' interest in a topic is also a weakness in this study. Future research should combine Google Trends data with survey data to reach out to people who have no access to internet.

REFERENCES

[1] C. Menni *et al.*, "Vaccine side-effects and SARS-CoV-2 infection after vaccination in users of the COVID Symptom Study app in the UK: a prospective observational study," *The Lancet Infectious Diseases*, vol. 21, no. 7, pp. 939–949, 2021, doi: 10.1016/S1473-3099(21)00224-3.

[2] A. L. Beatty *et al.*, "Analysis of COVID-19 Vaccine Type and Adverse Effects Following Vaccination," *JAMA Network Open*, vol. 4, no. 12, 2021, doi: 10.1001/jamanetworkopen.2021.40364.

[3] S. K. Syan *et al.*, "COVID-19 Vaccine Perceptions and Differences by Sex, Age, and Education in 1,367 Community Adults in Ontario," *Frontiers in Public Health*, vol. 9, 2021, doi: 10.3389/fpubh.2021.719665.

[4] S. Mahmud, M. Mohsin, I. A. Khan, A. U. Mian, and M. A. Zaman, "Knowledge, beliefs, attitudes and perceived risk about COVID-19 vaccine and determinants of COVID-19 vaccine acceptance in Bangladesh," *PLoS ONE*, vol. 16, no. 9 September, 2021, doi: 10.1371/journal.pone.0257096.

[5] S. Nomura *et al.*, "Reasons for being unsure or unwilling regarding intention to take COVID-19 vaccine among Japanese people: A large cross-sectional national survey," *The Lancet Regional Health - Western Pacific*, vol. 14, 2021, doi: 10.1016/j.lanwpc.2021.100223.

[6] C. Lin, P. Tu, and L. M. Beitsch, "Confidence and receptivity for covid-19 vaccines: A rapid systematic review," *Vaccines*, vol. 9, no. 1, pp. 1–32, 2021, doi: 10.3390/vaccines9010016.

[7] R. Shekhar *et al.*, "COVID-19 vaccine acceptance among health care workers in the united states," *Vaccines*, vol. 9, no. 2, pp. 1–18, 2021, doi: 10.3390/vaccines9020119.

[8] I. MS *et al.*, "COVID-19 vaccine rumors and conspiracy theories: The need for cognitive inoculation against misinformation to improve vaccine adherence.," *PloS one*, vol. 16, no. 5, p. e0251605, 2021.

[9] A. Widayati, "Knowledge, perceptions, and awareness related to COVID-19 among the indonesian adults during the outbreak's escalation period: a cross-sectional online survey Yogyakarta Province, Indonesia," *Asia Pacific Journal of Public Health*, vol. 33, no. 4, pp. 448–450, May 2021, doi: 10.1177/10105395211001655.

[10] L. Rokach and O. Maimon, "Distance Measures for Numeric Attributes," *Data Mining and Knowledge Discovery Handbook*, pp. 322–352, 2005.

[11] M. Hossian *et al.*, "Factors affecting intention to take COVID-19 vaccine among Pakistani University Students," *PLoS ONE*, vol. 17, no. 2 February, 2022, doi: 10.1371/journal.pone.0262305.

[12] E. Humer, A. Jesser, P. L. Plener, T. Probst, and C. Pieh, "Education level and COVID-19 vaccination willingness in adolescents," *European Child and Adolescent Psychiatry*, 2021, doi: 10.1007/s00787-021-01878-4.

[13] P. Diaz, P. Reddy, R. Ramasahayam, M. Kuchakulla, and R. Ramasamy, "COVID-19 vaccine hesitancy linked to increased internet search queries for side effects on fertility potential in the initial rollout phase following Emergency Use Authorization," *Andrologia*, vol. 53, no. 9, 2021, doi: 10.1111/and.14156.

[14] S.-P. Jun, H. S. Yoo, and J.-S. Lee, "The impact of the pandemic declaration on public awareness and behavior: Focusing on COVID-19 google searches," *Technological Forecasting and Social Change*, vol. 166, p. 120592, May 2021, doi: 10.1016/j.techfore.2021.120592.

[15] C. Heerfordt and I. M. Heerfordt, "Has there been an increased interest in smoking cessation during the first months of the COVID-19 pandemic? A Google Trends study," *Public health*, vol. 183, pp. 6–7, 2020, doi: 10.1016/j.puhe.2020.04.012.

[16] O. A. Oto *et al.*, "Impact of the COVID-19 pandemic on interest in renal diseases," *Environmental Science and Pollution Research*, vol. 29, no. 1, pp. 711–718, 2022, doi: 10.1007/s11356-021-15675-8.

[17] O. E. Santangelo, S. Provenzano, and V. Gianfredi, "Infodemiology of flu: Google trends-based analysis of Italians' digital behavior and a focus on SARS-CoV-2, Italy," *Journal of Preventive Medicine and Hygiene*, vol. 62, no. 3, pp. E586–E591, 2021, doi: 10.15167/2421-4248/jpmh2021.62.3.1704.

[18] V. Gianfredi *et al.*, "Monitoring public interest toward pertussis outbreaks: an extensive Google Trends–based analysis," *Public Health*, vol. 165, pp. 9–15, 2018, doi: 10.1016/j.puhe.2018.09.001.

[19] B. Greiner, S. Tipton, B. Nelson, and M. Hartwell, "Cancer screenings during the COVID-19 pandemic: An analysis of public interest trends," *Current Problems in Cancer*, vol. 46, no. 1, 2022, doi: 10.1016/j.currproblcancer.2021.100766.

[20] I. Husain *et al.*, "Fluctuation of public interest in COVID-19 in the United States: Retrospective analysis of Google trends search data," *JMIR Public Health and Surveillance*, vol. 6, no. 3, 2020, doi: 10.2196/19969.

[21] A. Khakimova, L. Abdollahi, O. Zolotarev, and F. Rahim, "Global interest in vaccines during the COVID-19 pandemic: Evidence from Google Trends," *Vaccine: X*, vol. 10, 2022, doi: 10.1016/j.jvacx.2022.100152.

[22] E. Merrick, J. P. Weissman, and S. J. Patel, "Utilizing Google trends to monitor coronavirus vaccine interest and hesitancies," *Vaccine*, vol. 40, no. 30, pp. 4057–4063, 2022, doi: 10.1016/j.vaccine.2022.05.070.

[23] C. Deiana, A. Geraci, G. Mazzarella, and F. Sabatini, "Perceived risk and vaccine hesitancy: Quasi-experimental evidence from Italy," *Health Economics (United Kingdom)*, vol. 31, no. 6, pp. 1266–1275, 2022, doi: 10.1002/hec.4506.

[24] N. B. Sajjadi *et al.*, "United States internet searches for 'infertility' following COVID-19 vaccine misinformation," *Journal of Osteopathic Medicine*, vol. 121, no. 6, pp. 583–587, May 2021, doi: 10.1515/jom-2021-0059.

[25] Google News Initiative, "Google Trends: Understanding the data," *Google*, pp. 1–9, 2019.

[26] Y. Karyono, E. Tusianti, I. G. N. A. R. Gunawan, A. Nugroho, and A. Clarissa, "Indeks Pembangunan Manusia 2020." Badan Pusat Statistik, p. 130, 2021. [Online]. Available: https://www.bps.go.id/publication/2021/04/30/8e777ce2d7570ced44197a37/indeks-pembangunan-manusia-2020.html

[27] Ministry of Health of Republic Indonesia, "Peraturan Menteri Kesehatan Republik Indonesia Nomor 75 Tahun 2014," *Ministry of Health of Republic Indonesia*, vol. 3, no. 2. pp. 1–46, 2014. [Online]. Available: http://hukor.kemkes.go.id/uploads/produk_hukum/PMK No. 75 ttg Puskesmas.pdf

[28] M. Qiu, R. Li, and M. Chen, "Cluster Analysis on PEAD Using SUE Model with Quarterly Data," *iBusiness*, vol. 05, no. 01, pp. 31–34, 2013, doi: 10.4236/ib.2013.51b007.

[29] S. Maneewongvatana and D. Mount, "Analysis of approximate nearest neighbor searching with clustered point sets," 2002, pp. 105–123. doi: 10.1090/dimacs/059/06.

[30] M. L. Mchugh, "The Chi-square test of independence Lessons in biostatistics," *Biochemia Medica*, vol. 23, no. 2, pp. 143–149, 2013.

[31] N. Pandis, "The chi-square test," *American Journal of Orthodontics and Dentofacial Orthopedics*, vol. 150, no. 5, pp. 898–899, Nov. 2016, doi: 10.1016/j.ajodo.2016.08.009.

[32] L. L. Kupper, D. W. Hosmer, and S. Lemeshow, "Applied Logistic Regression," *Journal of the American Statistical Association*, vol. 85, no. 411, p. 901, Sep. 1990, doi: 10.2307/2290035.

[33] H. A. Park, "An introduction to logistic regression: From basic concepts to interpretation with particular attention to nursing domain," *Journal of Korean Academy of Nursing*, vol. 43, no. 2, pp. 154–164, 2013, doi: 10.4040/jkan.2013.43.2.154.

[34] P. Sedgwick and L. Marston, "Statistical question: Odds ratios," *BMJ (Online)*, vol. 341, no. 7769, p. 407, 2010, doi: 10.1136/bmj.c4414.
[35] T. Rudas, *Odds Ratios in the Analysis of Contingency Tables*. SAGE, 1998.
[36] M. James, "Some methods for classification and analysis of multivariate observations," *Proceedings of The Fifth Berkeley Symposium on Mathematical Statistics and Probability*, vol. 1, no. 14, pp. 281–297, 1967.
[37] B. Edwards, N. Biddle, M. Gray, and K. Sollis, "COVID-19 vaccine hesitancy and resistance: Correlates in a nationally representative longitudinal survey of the Australian population," *PLOS ONE*, vol. 16, no. 3, p. e0248892, Mar. 2021, doi: 10.1371/journal.pone.0248892.
[38] B. Honarvar *et al.*, "Knowledge, attitudes, risk perceptions, and practices of adults toward COVID-19: a population and field-based study from Iran," *International Journal of Public Health*, vol. 65, no. 6, pp. 731–739, 2020, doi: 10.1007/s00038-020-01406-2.
[39] J. R. Kerr, A. L. J. Freeman, T. M. Marteau, and S. van der Linden, "Effect of information about COVID-19 vaccine effectiveness and side effects on behavioural intentions: Two online experiments," *Vaccines*, vol. 9, no. 4, 2021, doi: 10.3390/vaccines9040379.
[40] E. Dubé, D. Gagnon, and M. Vivion, "Optimizing communication material to address vaccine hesitancy," *Canada Communicable Disease Report*, vol. 46, no. 2/3, pp. 48–52, 2020, doi: 10.14745/ccdr.v46i23a05.

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