

The association between the number of COVID-19 cases and COVID-19 vaccination among people using Geographic Information Systems (GIS) in Thailand's health zone 4

Phannathat Tanthanapanyakorn, Asst. Prof. Areesanguanchue, Nirobon Ma-oon, Dr. Klarnarong Wongpituk
Faculty of public health, Valaya Alongkorn Rajabhat
University under the Royal Patronage, Pathum-Thani, Thailand

Assoc. Prof. Dr. Warangkana Chankong
School of Health Sciences,
Sukhothai Thammathirat Open University,
Thailand

Boonprajak Junwin Boromarajonani
College of Nursing Nakhon Si Thammarat,
Faculty of Nursing,
Praboromarajchanok Institute

Abstract:- This is analytical research. The goal of this study was to examine the relationship between the number of COVID-19 cases and COVID-19 vaccination among people in Thailand's health zone 4. (Saraburi, Phra-Nakhon Si Ayutthaya, Pathum-Thani, Ang-Thong, Sing-Buri, Nonthaburi, Nakhon-Nayok, and Lop-Buri provinces). The research collected data on secondary research-related data from the Ministry of Public Health and the World Health Organization's reliable website. The information includes the number of COVID-19 cases involved in the research as well as data on COVID-19 vaccination coverage. March–November 2021 is the study period. The data in this study was examined using the frequency, percentage, mean, and standard deviation. Using correlation tests with both a GIS tool to investigate the association between variables.

The results of the research indicated that coverage for the first dose of the COVID-19 vaccine was significantly associated with the number of COVID-19 cases (before vaccination), at a level of 0.05, and in the same direction ($r = 0.763$). Furthermore, at a level of 0.05, coverage for the third dose of the COVID-19 vaccine was significantly associated with the number of COVID-19 cases (before vaccination), and in the same direction as the connection ($r = 0.712$). While there is no association between coverage for the second dose of the COVID-19 vaccine and the number of COVID-19 cases (before vaccination). However, obtaining COVID-19 vaccine coverage is critical to effectively reducing COVID-19 spread. As a result, policies and campaigns should be included in a diverse variety of relevant methods. The public, as well as governmental and private health organizations, must be continuously involved. Several sorts of media are necessary in the age of global communication. This, however, must be consistent with policy and result in an efficient and equitable operation.

Keywords:- The number of COVID-19 cases, Vaccination, Geographic Information Systems (GIS), Thailand.

I. INTRODUCTION

In the global outbreak of COVID-19 (20 Nov 2021), there are 257,053,759 patients and 5,158,017 fatalities.[1]

Vaccines against COVID-19 are being developed by scientists all around the world. These vaccinations are intended to boost the body's protection against the virus that causes COVID-19, providing the vaccine is safe for the body. Vaccines with promise against COVID-19 that are presently in development include: Inactivated vaccines are viruses that have been eliminated or weakened such that they no longer cause disease but can still stimulate the human body to develop an immune response. Vaccines derived from viral proteins are harmless protein fragments or shells that mimic the COVID-19 virus, encouraging the body to create an immune response in a safe manner. Virus-borne vaccines, which are safe, non-pathogenic viruses, provide a platform for the production of coronavirus proteins, which stimulate immune responses. Genetic RNA and DNA vaccines are sophisticated technological methods that employ genetically edited RNA or DNA to safely generate proteins that stimulate immune responses. There is currently no evidence that vaccinations other than those developed specifically for the SARS-Cov-2 virus can protect us from COVID-19. Scientists are investigating whether current vaccinations, such as the Bacille Calmette-Guérin (BCG) vaccine used to fight TB, can also neutralize COVID-19. As soon as there is evidence, the World Health Organization will assess these investigations. The COVID-19 vaccination against COVID-19 works by increasing the body's immune response to the SARS-Cov-2 virus. Vaccination boosts the body's immunity, lowering the chance of illness and its repercussions. If a person becomes infected with the illness, this immunity will aid the body in fighting the infection. Vaccination can also protect others who are in close proximity to the vaccinated person. Vaccination protects us from infection and death, reducing our chances of infecting others, which is critical. People at high risk of becoming seriously infected by COVID-19, such as healthcare providers, the elderly, and those with underlying medical conditions, should be especially protected.[2] COVID-19 vaccinations have been provided safely to millions of citizens. All of the COVID-19 vaccinations that have been approved have been thoroughly examined and are being monitored. COVID-19 vaccinations, like other vaccines, go through a rigorous, multi-stage testing procedure that includes major clinical studies involving tens of thousands of participants. These studies are especially designed to discover any potential safety issues. COVID-19

vaccinations, like any other vaccine, can have adverse effects, the majority of which are minor to moderate and recover on their own within the next few days. Clinical research results have suggested that more severe or long-lasting adverse effects are possible. Vaccines are assessed for harmful effects.[3] COVID-19 booster vaccination information will be added to COVID-19 passes for out-of-state travel in the United Kingdom. At this time, it will not be added to domestic travel passes, and only passengers who have obtained a booster or third dose vaccine will be eligible. On November 19, 2021, the British National Health Service (NHS) COVID-19 access card will disclose vaccination status. The Republic of the Philippines will allow travelers who have gotten the full COVID-19 vaccine to enter the country. Tourists from low-epidemic-risk nations are welcome to visit the country as soon as possible. The Federal Republic of Germany has re-enacted COVID-19 control measures aimed at people who have not been vaccinated. It requires people who use public transportation and work in certain places to provide evidence of a COVID-19 vaccination or proof of recovery from infection or a negative test result. In addition, activities in public areas such as sporting events, cultural events, and restaurant sit-downs are only allowed for vaccinated or recently recovered people. While Thailand has the COVID-19 situation (16 November 2021), it was found that the number of infected people across the country in the past 2 weeks tends to decline continuously. This has started to decline since mid-August 2021, with an average daily number of 20,000 cases per day. The results of tracking the trend of the number of infected by province, found that the number of provinces with the trend of daily infections decreased in total of 49 provinces. In addition, it was found that 25 provinces with a tendency to increase the number of daily cases of infection were 25 provinces. The results of the analysis of vaccination coverage in these provinces revealed that the coverage of the first dose vaccination was less than 70 % (the maximum percentage was 67.24, the lowest was 40.12%). While coverage for the second dose was less than 55%, the highest was 53.32%, and the lowest was 31.84%. The situation of COVID-19 in Thailand's health zone 4 found that the number of cases is as follows: Nonthaburi 58,881 cases, PathumThani 39,308 cases, PhraNakhon Si Ayutthaya 30,941 cases, Saraburi 31,548 cases, Lop Buri 17,344 cases, Sing Buri 3,307 cases, Ang Thong 10,838 cases, NakhonNayok 10,728 cases. While the coverage for the 1st dose of the COVID-19 vaccine is as follows: Nonthaburi Province 11.9%, PathumThani 3.7%, PhraNakhon Si Ayutthaya 3.6%, Saraburi 4%, Lop Buri 2.4%, Sing Buri 3.3%, Ang Thong 3%, NakhonNayok 4.2%. The coverage of the second dose of the COVID-19 vaccine is as follows: Nonthaburi 58.4%, PathumThani 72.8%, PhraNakhon Si Ayutthaya 61.5%, Saraburi 58.8%, Lop Buri 46.9%, Sing Buri 51.4%, Ang Thong 42.9%, NakhonNayok 47.9%. The coverage of the 3rd dose of the COVID-19 vaccine is as follows: Nonthaburi 66.6%, PathumThani 81.6%, PhraNakhon Si Ayutthaya 65.5%, Saraburi 62.2%, Lop Buri 50.4%, Sing Buri 55.5%, Ang Thong 52.6%, NakhonNayok 53.4%. However, Thailand's health zone 4 is a metropolitan area adjacent to Bangkok, which is an area of continuous COVID-19 outbreak. As an area of great importance to the Thai economy and with many important industrial zones, it is necessary to study the relationship between the number of

cases and the vaccination of the people. The goal of this project is to collect evidence to support the development of successful vaccination distribution programs.[1]

II. METHOD

This is an analytical study. The purpose of this study was to study association between the number of COVID-19 cases and COVID-19 vaccination among people in Thailand's health zone 4 (Saraburi, Phra-Nakhon Si Ayutthaya, Pathum-Thani, Ang-Thong, Sing-Buri, Nonthaburi, Nakhon-Nayok, and Lop-Buri, Province). It is really the metropolitan region surrounding Bangkok that has a persistent COVID-19 epidemic. The goal of this study is to gather evidence to support the establishment of effective vaccine distribution strategies. This is congruent with findings from a study titled COVID-19 Vaccination Acceptance in the Canton of Geneva. The findings revealed that research participants who wanted to get vaccinated had a desire to protect themselves, their communities, and/or society, as well as their family or friends, against the risk of SARS-CoV-2 infection. The results showed that the number of patients was related to the number of vaccinations.[4] Similar to the findings supported the possibility of SARS-CoV-2 vaccination-based protection, as well as long-term high protection against COVID-19-associated hospitalization and mortality.[5] The study used secondary research-related data from agencies affiliated with the Ministry of Public Health and the World Health Organization's trustworthy website. The data includes information on the number of COVID-19 cases involved in the study as well as data on COVID-19 vaccination coverage. The frequency, percentage, mean, and standard deviation were used to examine the data in this study. Analyzing the association between variables using correlation tests and a GIS application.

III. RESULT

According to the research, the following is the COVID-19 situation in Thailand's health zone 4: In Figure 1 and 2, Nonthaburi had 58,881 cases, Pathum Thani had 39,308 cases, Phra Nakhon Si Ayutthaya had 30,941 cases, Saraburi had 31,548 cases, Lop Buri had 17,344 cases, Sing Buri had 3,307 cases, Ang Thong had 10,838 cases, and Nakhon Nayok had 10,728 cases. Nonthaburi Province has 11.9 percent coverage for the first dose of the COVID-19 vaccination, Pathum Thani has 3.7 percent, Phra Nakhon Si Ayutthaya has 3.6 percent, Saraburi has 4 percent, Lop Buri has 2.4 percent, Sing Buri has 3.3 percent, Ang Thong has 3 percent, and Nakhon Nayok has 4.2 percent, as shown in Figure 3 and 4. Nonthaburi has 58.4 percent coverage of the second dose of the COVID-19 vaccine, Pathum Thani has 72.8 percent coverage, PhraNakhon Si Ayutthaya has 61.5 percent coverage, Saraburi has 58.8 percent coverage, Lop Buri has 46.9 percent coverage, Sing Buri has 51.4 percent coverage, Ang Thong has 42.9 percent coverage, and Nakhon Nayok has 47.9 percent coverage, as indicated in Figure 5 and 6. Nonthaburi has 66.6 percent coverage for the third dose of the COVID-19 vaccine, Pathum Thani has 81.6 percent coverage, Phra Nakhon Si Ayutthaya has 65.5 percent coverage, Saraburi has 62.2 percent coverage, Lop Buri has 50.4 percent coverage, Sing Buri has 55.5 percent coverage,

Ang Thong has 52.6 percent coverage, and Nakhon Nayok has 53.4 percent coverage, as shown in Figure 7 and 8.

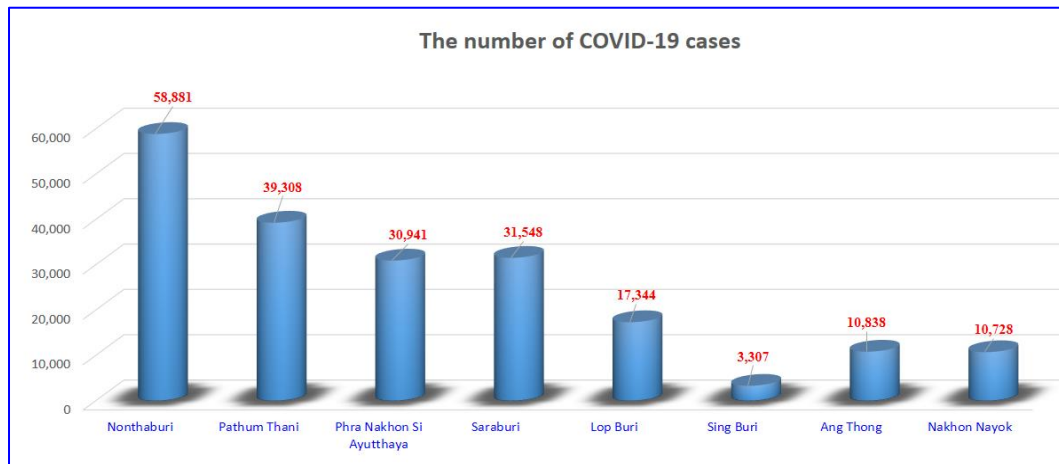


Fig. 1 : The COVID-19 situation in Thailand's health zone 4

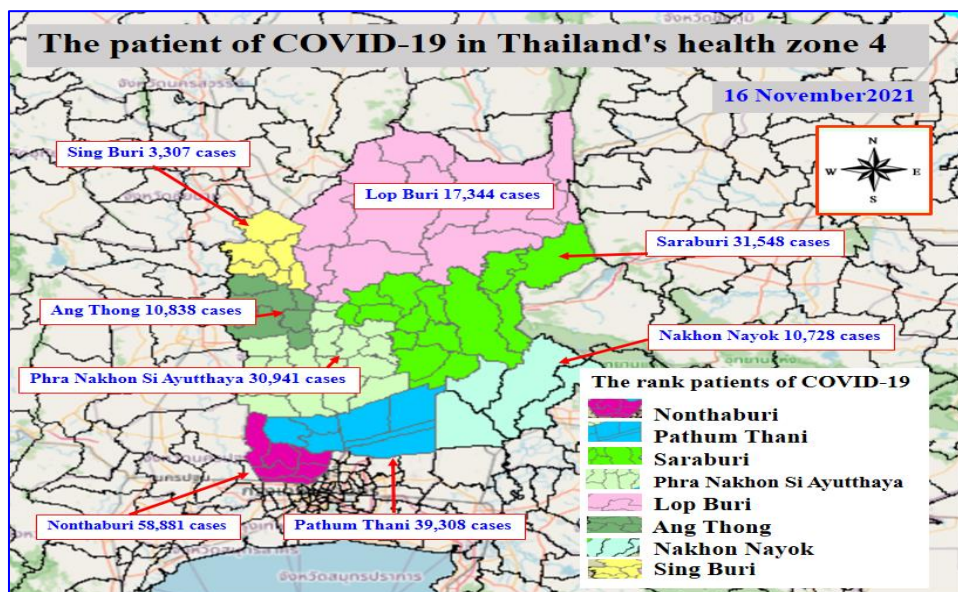


Fig. 2 : Map: The patient of COVID-19 in Thailand's health zone 4

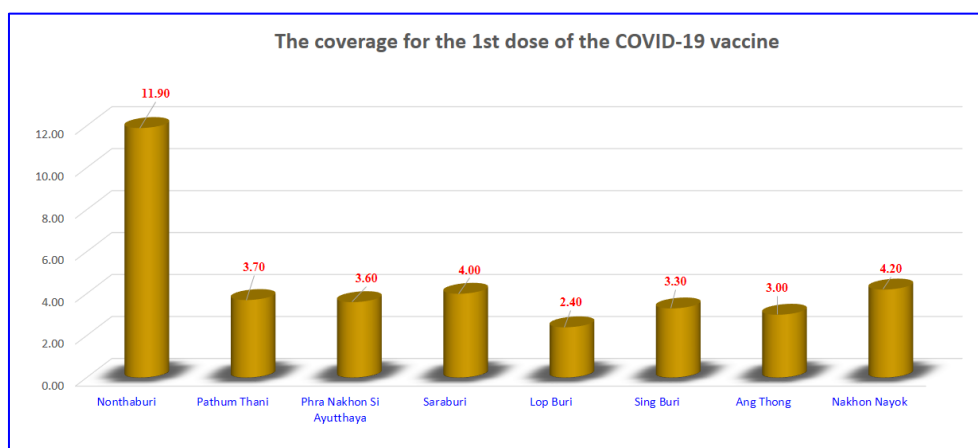


Fig. 3 : The coverage for the 1st dose of the COVID-19 vaccine

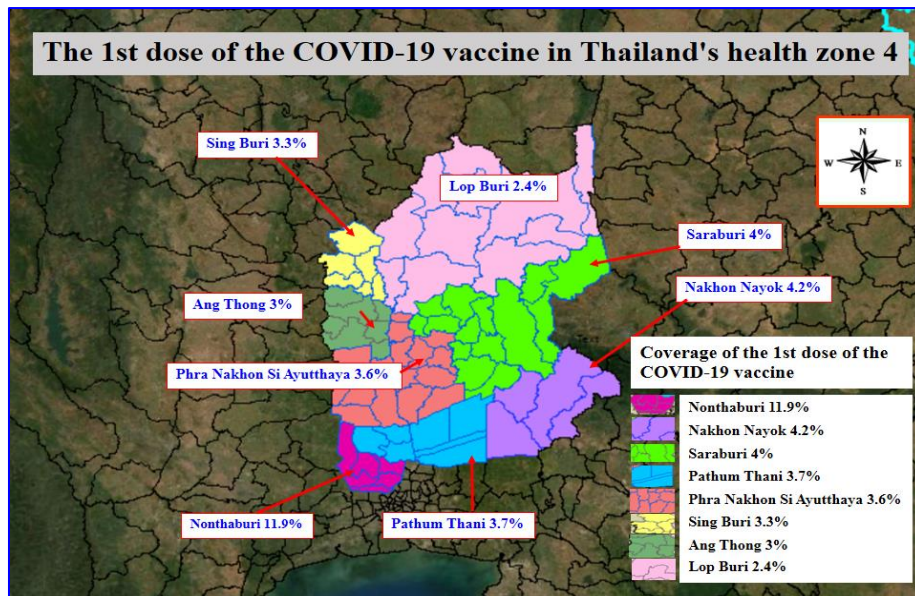


Fig. 4 Map: The coverage for the 1st dose of the COVID-19 vaccine

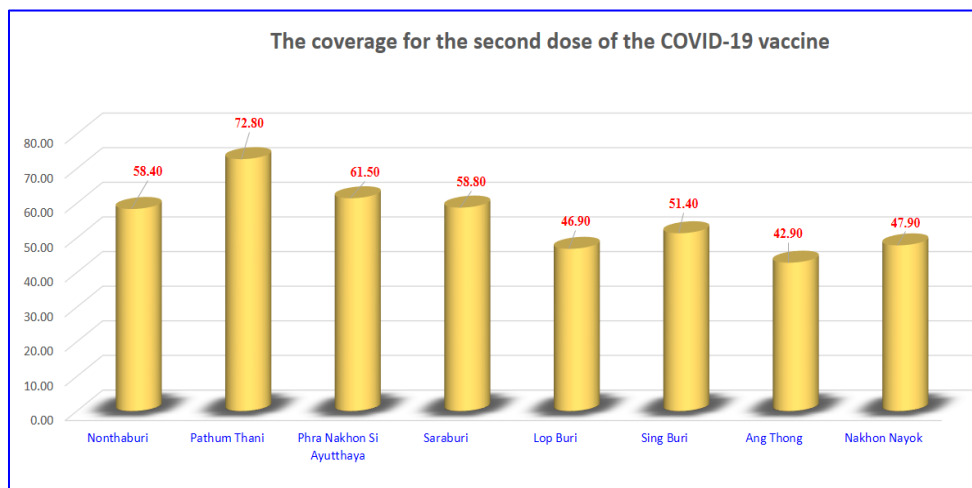


Fig. 5 : The coverage for the second dose of the COVID-19 vaccine

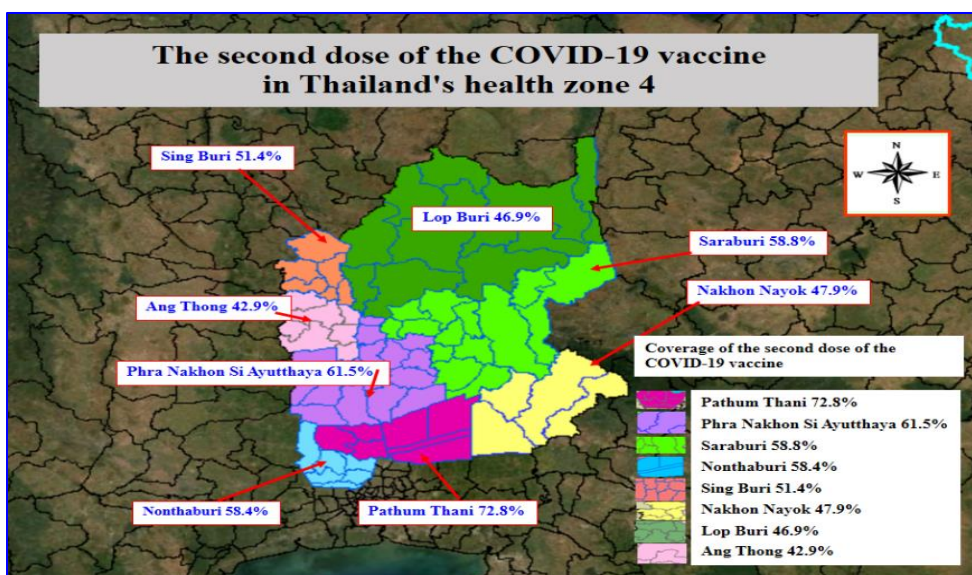


Fig. 6 Map: The coverage for the second dose of the COVID-19 vaccine

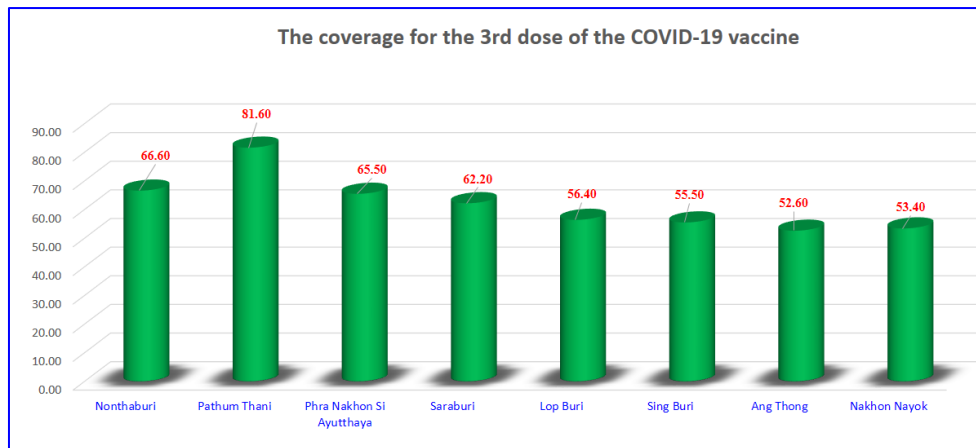


Fig. 7 : The coverage for the 3rd dose of the COVID-19 vaccine

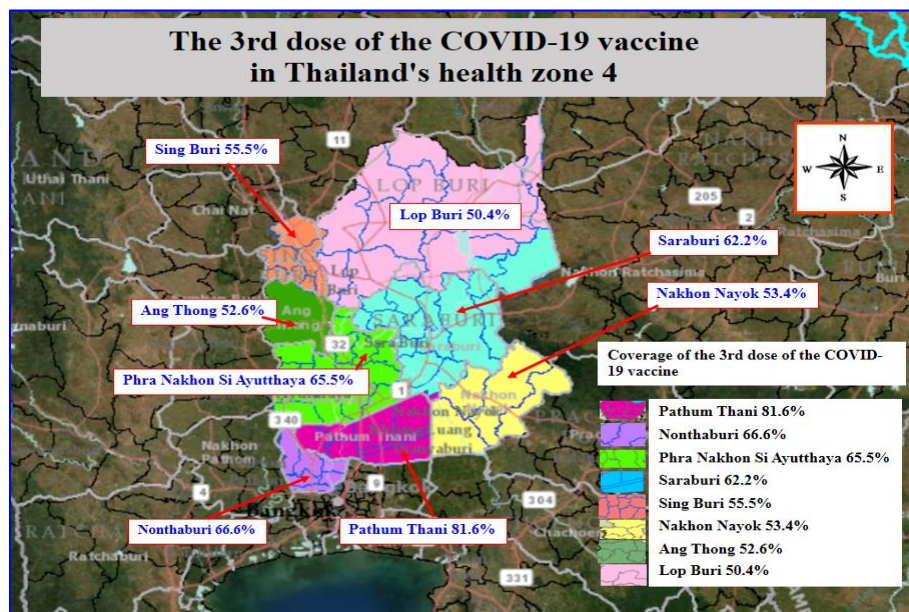


Fig. 8 Map: The coverage for the 3rd dose of the COVID-19 vaccine

Factors	The number of COVID-19 cases (Before vaccination)		
	Pearson Correlation (r)	Sig.(2-tailed)	Association level
The coverage for the 1st dose of the COVID-19 vaccine	0.763	0.028*	High level
The coverage for the second dose of the COVID-19 vaccine	0.677	0.065	No association
The coverage for the 3rd dose of the COVID-19 vaccine	0.712	0.047*	High level

Table 1 : Represents the relationship between coverage for the first, second, and third doses of the COVID-19 vaccine and the number of COVID-19 cases (before vaccination)

Using statistical correlation analysis, find out the relationship from table 1. The results indicated that coverage for the first dose of the COVID-19 vaccine was significantly associated with the number of COVID-19 cases (before vaccination), at a level of 0.05, and in the same direction ($r = 0.763$). Furthermore, at a level of 0.05, coverage for the third dose of the COVID-19 vaccine was significantly associated with the number of COVID-19 cases (before vaccination), and in the same direction as the connection ($r = 0.712$). While there is no association between coverage for the second dose of the COVID-19 vaccine and the number of COVID-19 cases (before vaccination).

IV. CONCLUSION AND DISCUSSION

The study's findings demonstrated that, at a level of 0.05, and in the same direction, coverage for the first and third doses of the COVID-19 vaccine was strongly correlated with the number of COVID-19 cases (before vaccination). This might be linked to the increasing anxiety of COVID-19 patients in the recent past. As a result, people are paying greater attention to the COVID-19 vaccination, which is critical. It may also result from public relations and vaccination campaigns conducted by the Ministry of Public Health or Local Government Organizations. Concurrently, private health services provide another alternative for people to acquire vaccinations throughout the country. Furthermore, the government has made it clear that educational institutions, such as colleges and universities, must have a management system in place to guarantee that students obtain the necessary COVID-19 vaccinations. All of the aforementioned may be both direct and indirect effects of people obtaining COVID-19 vaccines. Consistent with the interplay between vaccination and social distancing strategies affects COVID-19 population-level outcomes. The study provides insights into the factors that affect vaccination success. We find a strong interaction of vaccination effect on the proportion of hospitalizations. That may represent awareness before vaccination.[6] Similar to the role of information technology in the COVID-19 vaccination drive, an analysis of the COVID-19 global beliefs, behaviors, and norms survey The study discovered that vaccine receptivity is affected by norms. The results revealed that 65.06 percent of people worldwide are willing to get vaccinated, and a large majority of the population believes that the COVID-19 pandemic is a real threat to the community and that preventative actions, including vaccination programs, are necessary.[7] Consistent with COVID-19 vaccination acceptance in the canton of Geneva: a cross-sectional population-based study. The result showed that the participants that planned to be vaccinated expressed a wish to get back to normal and, protect themselves, their community, and their families or friends against the possibility of COVID-19 infection.[4] Consistent with strategies to support ontarians' capability, opportunity, and motivation for COVID-19 vaccination. The result showed that people who are already motivated to be vaccinated can overcome capability and opportunity concerns by receiving two doses of the COVID-19 vaccination using behavioral science-informed measures. These measures will be critical to achieving the aim of a fully vaccinated population.[8] Inconsistent with the study, a higher number of COVID-19

cases and fatalities in Israel phased with the start of the mass vaccination. As a result, the number of cases and the proportion of positive cases has increased since the vaccinations began. It was also discovered that public relations through the media would be beneficial following the COVID-19 vaccination.[9] COVID-19 might lead to a greater respect for vaccinations. However, surveys indicate a split in attitudes, with around 20% of Americans proactively rejecting any COVID-19 vaccination, owing in part to poor risk communication. While healthcare professionals (HCPs) will be heavily relied on to increase COVID-19 vaccine uptake, and while 70% of Americans obtain vaccination information from HCPs, 84% rely on peer networks.[10]

However, obtaining COVID-19 vaccine coverage is critical to effectively reducing COVID-19 spread. As a result, policies and campaigns should be integrated into a variety of relevant methods. The public, as well as public and private health organizations, must be involved on an ongoing basis. In the age of global communication, several types of media are essential. This must, however, be compatible with policy and result in efficient and equitable functioning. However, obtaining COVID-19 vaccine coverage is critical to effectively reducing COVID-19 spread.

V. ACKNOWLEDGMENT

The research team wishes to express their gratitude to the President and other leaders of Valaya Alongkorn Rajabhat University under royal patronage. Thank you to the Dean of the Faculty of Public Health and other faculty members who provided helpful about research. We would like to thank all the faculty and employees at the Faculty of Public Health for their support and facilitation in a variety of sectors. We'd like to thank our friends for their advice, support, and encouragement during the research.

REFERENCES

- [1.] Department of disease control. Viral pneumonia [Internet]. Ministry of Public Health, Thailand; 2021 [cited 2021 Nov 15]. Available from: <https://ddc.moph.go.th/viralpneumonia/file/situation/situation-no687-201164.pdf>
- [2.] World Health Organization. Coronavirus disease (COVID-19) questions and answers on vaccine [Internet]. World Health Organization, Thailand; 2021 [cited 2021 Nov 18]. Available from: <https://www.who.int/thailand/emergencies/novel-coronavirus-2019/q-a-on-covid-19/q-a-on-covid-19-vaccines>
- [3.] World Health Organization. Coronavirus disease (COVID-19): Vaccines safety [Internet]. World Health Organization, Thailand; 2021 [cited 2021 Nov 18]. Available from: [https://www.who.int/news-room/questions-and-answers/item/coronavirus-disease-\(covid-19\)-vaccines-safety](https://www.who.int/news-room/questions-and-answers/item/coronavirus-disease-(covid-19)-vaccines-safety)
- [4.] Wisniak A, Baysson H, Pullen N, Nehme M, Pennacchio F, Zaballa ME, Guessous I, Stringhini S, Specchio-COVID19 study group. COVID-19 Vaccination acceptance in the canton of Geneva: A

- Cross-Sectional Population-Based Study. medRxiv. 2021 Jan 1
- [5.] Scobie HM, Johnson AG, Suthar AB, Severson R, Alden NB, Balter S, Bertolino D, Blythe D, Brady S, Cadwell B, Cheng I. Monitoring incidence of covid-19 cases, hospitalizations, and deaths, by vaccination status—13 US jurisdictions, April 4–July 17, 2021. *Morbidity and Mortality Weekly Report*. 2021 Sep 17;70(37):1284.
- [6.] Guerstein S, Romeo-Aznar V, Dekel MA, Miron O, Davidovitch N, Puzis R, Pilosof S. The interplay between vaccination and social distancing strategies affects COVID19 population-level outcomes. *PLoS computational biology*. 2021 Aug 20;17(8):e1009319.
- [7.] Talukdar D, Stojkovski K, Suarez D. Role of Information Technology in COVID19 Vaccination Drive: An Analysis of the COVID-19 Global Beliefs, Behaviors, and Norms Survey. 2021
- [8.] Presseau J, Arnason T, Buchan JL. Strategies to support Ontarians' capability, opportunity, and motivation for COVID-19 vaccination. *Science Briefs of the Ontario COVID-19 Science Advisory Table*. 2021; 2 (36).
- [9.] Boretti A. A Higher Number of Covid19 Cases and Fatalities in Israel Phased With the Start of the Mass Vaccination. *Health Services Research and Managerial Epidemiology*. 2021 Mar 29;8:23333928211005867.
- [10.] Vojtek I, Palsenbarg V, Smyser J. 65. Vaccine Confidence, COVID19, and the Influence of Peer Networks. In *Open Forum Infectious Diseases* 2020 Oct (Vol. 7, No. Suppl 1, p. S164). Oxford University Press.