Assessment of COVID-19 Vaccination Services During the 5th Wave of the Outbreak in Thailand

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Abstract

The COVID-19 epidemic has expanded globally and remains a significant issue in every country. Vaccines continue to attract attention from countries worldwide, whether for preventing the spread of COVID-19 or mitigating the severity of the disease. This study has been classified as a correlation study aimed at investigating the COVID-19 vaccine landscape, particularly focusing on the relationship between the number of vaccine recipients and the incidence of COVID-19 cases. Secondary data were obtained by the researchers from departments and organizations affiliated with the Ministry of Public Health. The survey encompassed six primary tourist cities situated in major urban areas of Thailand. The researchers utilized data pertaining to the fifth wave of outbreaks (occurring within a 14-day cycle) across six provinces, alongside data on the number of individuals who received COVID-19 vaccinations. To analyze the data in this study, statistical methods including frequency, percentage, mean, standard deviation, correlation, and Geographic Information System (GIS) were employed. The findings revealed that receiving at least one dose of the COVID-19 vaccine was significantly correlated with the prevalence rate of COVID-19 per 100,000 individuals at a significance level of 0.05 (R^2 = 0.82). Furthermore, at a significance level of 0.05, full vaccination against COVID-19 was significantly associated with the prevalence rate of COVID-19 per 100,000 individuals, showing a correlation coefficient of 0.829 in the same direction. Additionally, at a significance level of 0.01, the number of COVID-19 cases within a 14-day period exhibited a strong correlation with the trend of COVID-19 incidence, which decreased over approximately 14 days, indicating an inverse relationship (R^2 = -0.928). Lastly, at a significance level of 0.05, the prevalence rate of COVID-19 per 100,000 individuals was significantly correlated with the trend of COVID-19 incidence, which decreased over approximately 14 days, again demonstrating an inverse relationship (R^2 = -0.812).

Keywords: COVID-19 Outbreak, COVID-19 Vaccination, Prevent COVID-19

1. Introduction

COVID-19 has been circulating in Thailand and throughout the world for approximately three years, and the pandemic is expected to persist. Efforts to mitigate the impact of the pandemic, however, have never ceased. Policies and recommendations for early and effective COVID-19 monitoring, control, and prevention, including vaccination, are crucial for pandemic control. The policies and practices regarding early surveillance, control, and prevention of COVID-19 are indispensable. Establishing an efficient border screening system and ensuring an adequate number of trained professionals to implement it will aid in halting the spread of COVID-19 [1]. A COVID-19 vaccine, a vital tool in preventing the disease's transmission among individuals globally, has been developed and made available for a limited period. Its aim is to provide a swift response to the global outbreak of new diseases. Despite being developed in significantly less time than other vaccines, the efficacy of the COVID-19 vaccine has not been compromised. Over 200 laboratory-selected vaccines from around the world have undergone rigorous development, efficacy, quality, and safety assessments.

However, only a few of these vaccines have received approval from the Vaccine Quality Supervisory Authority. COVID-19 is being combated through vaccinations. A team of researchers from The MRC Centre for Global Infectious Disease Analysis, an advisor to the World Health Organization, conducted a study to evaluate various COVID-19 vaccines across 185 countries, including Thailand, over a one-year period (2021).

According to the research findings, COVID-19 vaccinations globally have saved the lives of over 20 million individuals. In Thailand, it was found that the COVID-19 vaccine contributed to saving the lives of 382,600 Thai citizens. However, this data does not account for the Omicron strain epidemic. Subsequently, scholars from Mahidol University's Faculty of Science and Naresuan University's Faculty of Science collaborated on a study conducted at the onset of the Omicron virus epidemic. The results indicated that all types of COVID-19 vaccinations remained effective, contributing to the survival of approximately 107,400 more Thai individuals during the Omicron outbreak. When considering all available information, existing vaccinations were estimated to have aided in the survival of approximately 490,000 Thai citizens. Due to the rapid and constant mutation of the virus, significant alterations occur, rendering two vaccine doses insufficient to provide long-lasting immunity. Consequently, the natural waning of immunity over time is inadequate in preventing COVID-19 infection. Furthermore, aside from the inability to prevent violence and death resulting from COVID-19 infection, as observed in [2], efforts to develop vaccines specifically targeting mutant virus strains have encountered challenges. Vaccine research is time-consuming, and vaccine development may struggle to keep pace with the virus's rapid evolution.

Monitoring of the COVID-19 vaccination service was conducted using data from the Ministry of Public Health Immunization Center database. According to the findings, the cumulative number of vaccination recipients from February 28, 2021, to June 26, 2022, totaled 139,602,400 doses across 77 regions nationwide. Among these, 56,961,123 individuals received the first dose of the vaccine, alongside 864,976 healthcare workers. Village health volunteers attended to 789,341 individuals, including those with chronic illnesses, distributed among seven groups totaling 5,107,613 people. The breakdown further includes 34,628,454 individuals from the general population, 8,650,154 cases, and 3,766,685 students, with adolescents aged 12–17 accounting for 3,153,900 and children aged 5–11 numbering 3,153,900, as indicated in [3]. Additionally, 53,131,864 individuals received two doses of the vaccine, with 849,679 healthcare workers and 777,864 village health volunteers involved in the process. The number of individuals affected by seven chronic diseases amounted to 4,930,637, with 32,535,111 individuals from the general population, including 8,287,013 students aged 60 and over, 3,726,019 adolescents aged 12 to 17, and 2,025,541 children aged 5 to 11, as detailed in [3]. During the period spanning 2017 to 2020, tourism earnings predominantly centered on major cities with high tourist footfall, including Bangkok, Phuket, Chon Buri, Chiang Mai, Krabi, and Surat Thani. Bangkok accounted for the largest share, representing no less than 30% of the overall tourism earnings.

Consequently, this research is crucial for preparedness against potential outbreaks of COVID-19 or other infectious diseases. The previous study [4] highlighted a significant association between individuals' perceptions of COVID-19 severity and their adherence to COVID-19 preventive behaviors ($p = 0.001$), suggesting a possible link between such perceptions and COVID-19 vaccine uptake. Based on the literature review and relevant data, it is evident that there is a necessity for research due to the ongoing COVID-19 pandemic, which remains a significant problem globally, including in Thailand. Despite the development of various COVID-19 vaccines, such as messenger RNA (mRNA) vaccines, Viral Vector Vaccines, Inactivated Vaccines, and Protein Subunit Vaccines, disparities in vaccine access among populations worldwide, including in Thailand, have been observed. The research team is therefore interested in exploring the relationship between the number of vaccine doses received by the population and the incidence of COVID-19. This study aims to investigate data from six major tourist cities in Thailand, which are areas with a high risk of disease transmission.

The project concept centers around conducting a comprehensive assessment of COVID-19 vaccination services during the fifth wave of the outbreak in Thailand. The research aims to understand the landscape of COVID-19 vaccination, especially investigating the relationship between the number of vaccine recipients and the incidence of COVID-19 cases in six major tourist cities in Thailand. This inquiry is crucial given the ongoing global challenge posed by COVID-19 and the pivotal role of vaccines in preventing the spread of the virus and mitigating the severity of the disease.

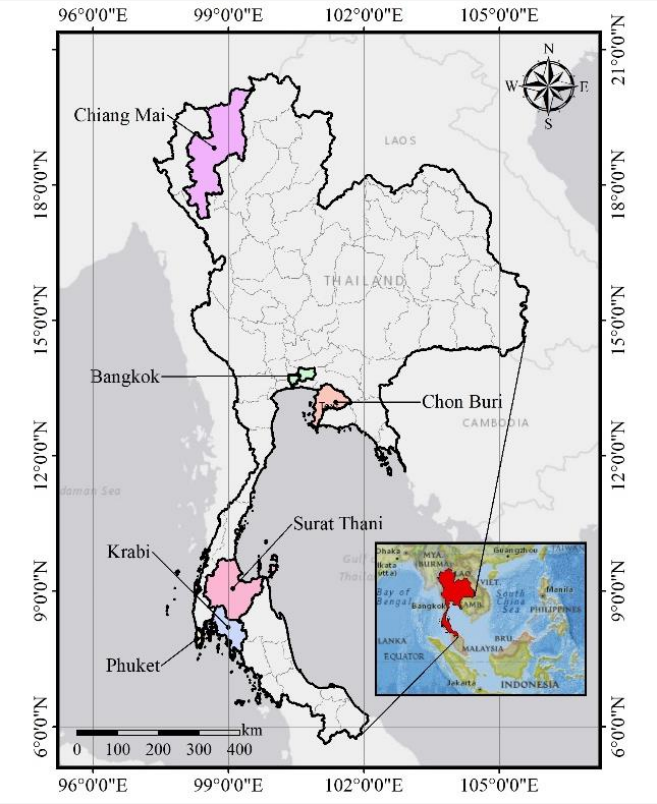

Figure 1: The map of Thailand and 6 provinces under the study

2. Study Area & Method

2.1 Study Area

Thailand situated in the heart of Southeast Asia on the Indochinese Peninsula, spans from approximately 5°40′N to 20°30′N latitude and from 97°30′E to 105°30′E longitude, covering a total area of 513,120 km^2, ranking as the 50th largest country in the world. With a population nearing 70 million, Thailand is bordered to the northwest by Myanmar, to the northeast and east by Laos, to the southeast by Cambodia, and to the south by the Gulf of Thailand and Malaysia. Additionally, it shares maritime boundaries with Vietnam to the southeast and Indonesia to the southwest, while the Andaman Sea graces its southwestern shores. In this study, the analysis focused on six provinces with the highest vaccination rates. These provinces include Bangkok, Chiang Mai, Chonburi, Krabi, Surat Thani, and Phuket, as illustrated in Figure 1.

2.2 Methods

This research has been identified as a correlation study, characterized by an investigation into the relationship between variables. The aim of the study was to investigate the COVID-19 vaccine landscape, specifically focusing on the relationship between the number of vaccine recipients and the incidence of COVID-19 cases. Higher vaccination rates were associated with a lower number of COVID-19 cases and deaths, a trend observed throughout the Delta variant outbreak. Vaccination coverage rates correlated with both a higher incidence of COVID-19 and a higher death rate, with a ratio of 2.2 times [5]. Spatial analysis revealed that areas with low vaccination rates exhibited elevated incidence and death rates [6]. Residents in areas with low vaccination rates experienced a more pronounced increase in new infections during the third wave of the pandemic [7], primarily attributable to the Delta variant [8]. The researcher collected secondary data from departments and organizations affiliated with the Ministry of Public Health. The study encompassed six major tourist cities in Thailand's urban centers. Data pertaining to the fifth wave of outbreaks (occurring within a 14-day cycle) across six provinces and the number of individuals who received COVID-19 vaccinations were utilized. Statistical methods including frequency, percentage, mean, standard deviation, correlation, and Geographic Information System (GIS) analysis were employed to analyze the data in this study.

Table 1: The number of COVID-19 cases, Prevalence rate per 100,000 people, at least one dose of vaccine and vaccination coverage by province (Major tourist cities)

No	Province	Number of Patients within 14 days	Prevalence Rate per 100,000 People	Single Dose of Vaccination (%)	Fully Vaccinated (%)
1	Bangkok	40,033	519	100.0	100.0
2	Phuket	1,852	338	90.9	86.0
3	Chonburi	8,187	399	97.3	92.4
4	Chiang Mai	2,615	151	92.8	89.8
5	Krabi	708	140	74.2	69.2
6	Surat Thani	1,064	92	79.0	73.3

Table 2: The COVID-19 decreasing rate: about 14 days by province (Major tourist cities)

No	Province	COVID-19 Decreasing Rate: about 14 days (%)
1	Bangkok	8
2	Phuket	47
3	Chonburi	39
4	Chiang Mai	63
5	Krabi	51
6	Surat Thani	46

Table 3: Correlation between number of patients within 14 days, prevalence rate per 100,000 people, COVID-19 trend: about 14 days and at least one dose of vaccine

Factors	At least one dose of vaccine		
	Pearson Correlation (r)	Sig. (2-tailed)	Relationship level
Number of patients within 14 days	0.631	0.179	-
Prevalence rate per 100,000 people	0.82	0.046*	High
COVID-19 decreasing rate: about 14 days	-0.564	0.244	-

** Significant at P < 0.05*

3. Result

The results of this study revealed that among the six main tourist cities, Bangkok reported the highest number of patients within a 14-day period, with 40,033 cases. Chonburi and Chiang Mai followed, with 8,187 and 2,615 cases, respectively, as depicted in Figure 2(a). Furthermore, Bangkok exhibited the highest COVID-19 prevalence rate, standing at 519 per 100,000 individuals, with Chonburi and Phuket ranking second and third, at 399 and 338, respectively, as illustrated in Figure 2(b). Regarding vaccination rates, the single-dose vaccination was most prevalent in Bangkok, followed by Chonburi and Chiang Mai, with rates of 100%, 97.3%, and 92.8%, respectively, as displayed in Figure 2(c). Bangkok also boasted the highest vaccination coverage percentage, reaching 100%, with Chonburi and Chiang Mai trailing at 92.4% and 89.8%, respectively, as detailed in Table 1 and Figure 2(d). Chiang Mai exhibited the most significant decrease in COVID-19 cases around the 14-day mark, with a rate of 63%, while Krabi and Phuket ranked second and third, with rates of 51% and 47%, respectively. Conversely, Bangkok witnessed the lowest decrease in COVID-19 cases around the 14-day mark, at 8%, as indicated in Table 2 and Figure 2(e). Statistical analysis technique was utilized to determine the relationship, according to Table 3, at a significance level of 0.05, at least one dose of the COVID-19 vaccination was significantly associated with the COVID-19 prevalence rate per 100,000 people, showing a positive correlation ($R^2 = 0.82$).

However, it was observed that at least one dose of the COVID-19 vaccination did not affect the number of patients within 14 days, as the COVID-19 trend decreased around the 14-day mark. Subsequently, employing correlation statistical analysis, at a significance level of 0.05, fully COVID-19 vaccination was also found to be significantly correlated with the COVID-19 prevalence rate per 100,000 people, in the same positive direction (R^2 = 0.829). Nevertheless, full COVID-19 immunization exhibited no influence on the number of patients within 14 days, and the COVID-19 trend decreased around the 14-day mark, as evidenced in Table 4. Furthermore, at a significance level of 0.01, the number of patients within 14 days demonstrated a strong negative correlation with the COVID-19 trend, which decreased around the 14-day mark (R^2 = -0.928). Similarly, at a significance level of 0.05, the COVID-19 prevalence rate per 100,000 people exhibited a substantial negative correlation with the COVID-19 trend, which decreased around the 14-day mark (R^2 = -0.812). Both at least one dose of vaccine and complete COVID-19 vaccination displayed no effect on the COVID-19 trend, which decreased around the 14-day mark, as illustrated in Table 5.

Table 4: Correlation between number of patients within 14 days, prevalence rate per 100000 people, COVID-19 trend decreases: about 14 days and complete vaccination

Factors	Complete vaccination		
	Pearson Correlation (r)	Sig. (2-tailed)	Relationship level
Number of patients within 14 days	0.713	0.112	-
Prevalence rate per 100,000 people	0.829	0.041*	High
COVID-19 decreasing rate: about 14 days	-0.564	0.244	-

** Significant at P< 0.05*

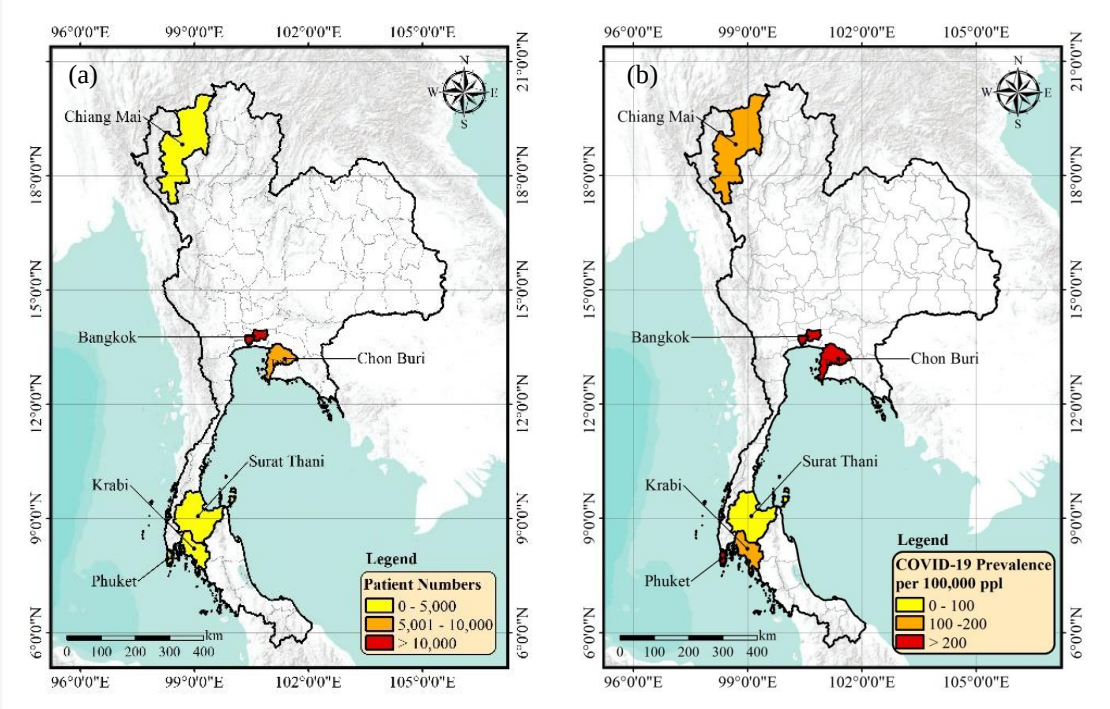

Figure 2: (a) number of patients within 14 days (b) COVID-19 prevalence rate per 100,000

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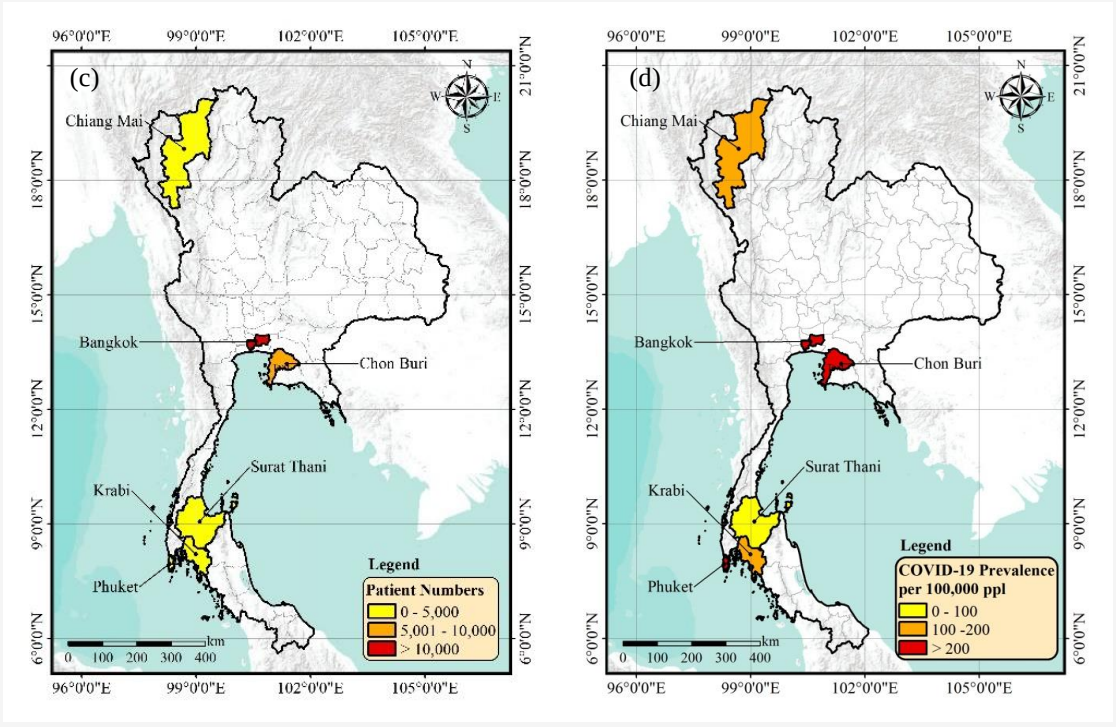

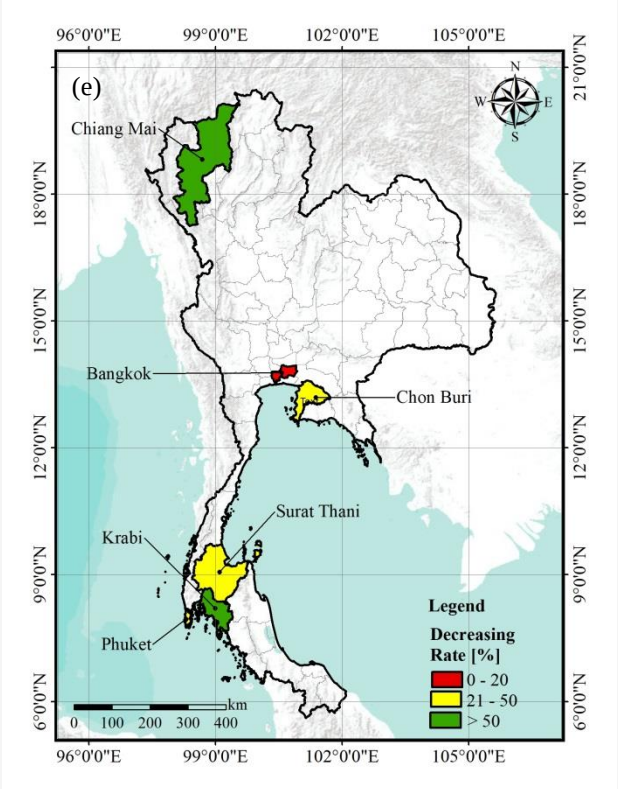

Figure 3: (c) percentage of single dose vaccination (d) percentage fully vaccinated (e) COVID-19 decreasing rate (continue from previous page)

Table 5: Correlation between number of patients within 14 days, prevalence rate per 100000 people, at least one dose of vaccine, complete vaccination and COVID-19 decreasing rate: about 14 days

Factors	COVID-19 trend: about 14 days		
	Pearson Correlation (r)	Sig. (2-tailed)	Relationship level
Number of patients within 14 days	-0.928	0.008*	High
Prevalence rate per 100000 people	-0.812	0.049*	High
Single dose vaccination	-0.506	0.306	-
Fully vaccinated	-0.564	0.244	-

** Significant at P < 0.05*

4. Discussion

The findings of this study revealed a significant correlation ($R^2 = 0.82$) at a significance level of 0.05 between a single dose of COVID-19 vaccination and the COVID-19 prevalence rate per 100,000 people, indicating a positive association. the results coincide with the previous study that the vaccinations are safe, efficient, and capable of reducing the transmission of SARS-CoV-2 infection and its variants, as well as the clinical effects of the emergence of coronavirus disease-19 (COVID-19) [9]. Additionally, the vaccines help reduce the incidence, hospitalization, and mortality from COVID-19: A systematic review and meta-analysis" found that the pooled vaccine effectiveness (PVE) against SARS-CoV-2 infection was 71% [odds ratio (OR) = 0.29, 95% CI: 0.23-0.36] after the first dose. The reduction in SARS-CoV-2 infection rates among recipients of the first doses of BNT162b2 mRNA, mRNA-1273, and ChAdOx1 vaccines was 56% (IRR = 0.44, 95% CI: 0.31-0.61), 66% (IRR = 0.34, 95% CI: 0.11-1.02), and 46% (IRR = 0.54, 95% CI: 0.12-2.48), respectively.

The COVID-19 trend exhibits a decrease around the 14-day mark, despite the fact that at least one dose of the vaccination had no impact on the number of patients within 14 days. The efficacy of the Ad26.COV2.S one-dose regimen against Covid-19 was 74.8% (95% CI, 72.5 to 76.9) at 1 month, dropping to 59.4% (95% CI, 57.2 to 61.5) after 5 months. This highlights the strong correlation between the incidence of COVID-19 and each dosage of the vaccination [10]. Additionally, the first dose of the BNT162b2 vaccine was associated with a vaccine effect of 85% (95% CI 76 to 91) for COVID-19-related hospitalization at 28–34 days post-vaccination. ChAdOx1 vaccination exhibited a 94% (95% CI 73 to 99) vaccine effect within the same timeframe [11]. This underscores the significant association between the occurrence of COVID-19 and each dose of the vaccination. At a significance level of 0.05, full vaccination against COVID-19 demonstrated a significant positive correlation with the COVID-19 prevalence rate per 100,000 people ($R^2 = 0.829$). Vaccination serves as a crucial defense against COVID-19, including its variants like the Delta strain. Monitoring COVID-19 incidence based on vaccination status can offer early indications of changes in vaccine-related protection, which can be further investigated through well-controlled studies of vaccine effectiveness (VE) [12]. However, full COVID-19 vaccination did not impact the number of infections within a 14-day period.

At the 14-day mark, overall COVID-19 vaccination did not influence the declining trend of COVID-19 cases. Surprisingly, there appears to be a positive correlation, with countries having a higher proportion of fully vaccinated individuals reporting more COVID-19 infections per million people. Notably, Israel, despite having over 60% of its population fully vaccinated, recorded the highest number of COVID-19 infections per 1 million individuals in the preceding 7 days [13].

At a level of 0.01, the number of patients within 14 days was strongly related to the COVID-19 trend, which decreases at about 14 days and in the inverse direction (r =-0.928). This might be due to an outbreak in any location with a high number of patients, and countermeasures will be implemented in order to prevent the outbreak. It was discovered that if the lockdown was lifted, the number of epidemics in mainland China outside of Wuhan would more than double. The AI model used predicts the peak and magnitude of the COVID-19 epidemic, which is being controlled by the Chinese government. The city lockdown measures, in particular, help to minimise the scope of the COVID-19 pandemic [13].

At a significance level of 0.05, the COVID-19 prevalence rate per 100,000 people was found to be substantially associated with the COVID-19 trend, which exhibited a decrease over approximately 14 days and in the opposite direction ($R^2 = -0.812$).

The COVID-19 outbreak in any location with a high prevalence rate per 100,000 people necessitates the implementation of countermeasures to prevent further spread. Upon analyzing the high prevalence of the epidemic in Wuhan, an AI model was employed to examine the epidemic trend in locations outside of Wuhan. It was determined that lifting the lockdown would result in more than doubling the number of epidemics in mainland China, excluding Wuhan [14].

At least one dose of the vaccine and complete COVID-19 vaccination showed no effect on the COVID-19 trend, which exhibits a decrease over approximately 14 days. According to the findings of [15], a 10% increase in COVID-19 vaccinations was associated with a 7% decrease in COVID-19 incidence. During the Alpha and Delta variants, higher levels of COVID-19 vaccine coverage were correlated with lower COVID-19 incidences. In the United States, higher vaccination coverage is linked to decreased population-level occurrences of COVID-19.

5. Conclusion

It has been demonstrated that the COVID-19 vaccine effectively protects against COVID-19. Alongside the use of masks, maintaining physical distance, frequent hand washing, and avoiding crowded places, this measure is imperative. The COVID-19 vaccination stimulates the body's immunity against the virus and enhances the prevention of future infections. Immunity takes time to develop after vaccination. In Thailand, the Ministry of Public Health has established a system for providing COVID-19 vaccinations to all citizens through online reservations and walk-ins at hospitals. Therefore, it is essential for everyone to receive the COVID-19 vaccinations and booster shots as recommended by the Ministry of Public Health. This is crucial for protection against COVID-19 or for reducing the severity of a COVID-19 infection. Therefore, for the control and prevention of COVID-19 to be maximally effective, it is imperative to ensure equitable vaccine distribution, effective public health policies, and impactful community engagement in the fight against the COVID-19 pandemic. Governments must build and develop robust public health infrastructure, foster international cooperation, and devise appropriate strategies. Moreover, all sectors must prioritize enhancing pandemic management and preparing for future health emergencies, emphasizing a multi-dimensional approach to addressing public health challenges.

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