Real-World Evidence of Full Vaccination Impact on COVID-19 Cases: Evidence from Malaysian Districts Using An Instrumental Variable Approach

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Rationale – *Why this study?*

- Fast vaccination rollout in Malaysia
- Simple correlation ≠ true causal effect
- Self-selection & unequal access → bias
- Better districts: higher vaccination **and** better outbreak control
- Need robust method to tackle endogeneity
- Instrumental Variable (IV) approach: stronger causal inference

Objective

To estimate the **causal impact** of full vaccination on the COVID-19 cases at the district level in Malaysia.

1. Does full vaccination coverage significantly reduce COVID-19 cases?
2. How do sociodemographic and economic variables interact with vaccination rates to influence case numbers?

Methods

Data:

Aggregated data at the district level.

Approach: The IV is the number of local health clinics designated as vaccination centres in each district.

Study Period: 24th February 2021 to 19th October 2022.

Sample Size: 158 districts

IV Justification

Exclusion Criteria:

Vaccination centers may induce selection in the vaccination uptake

Outbreak in the vaccination centers contribute to the number of cases

Vaccination centers maybe correlated with unobserved characteristics that may influence the number of cases

IV Validity Justification:

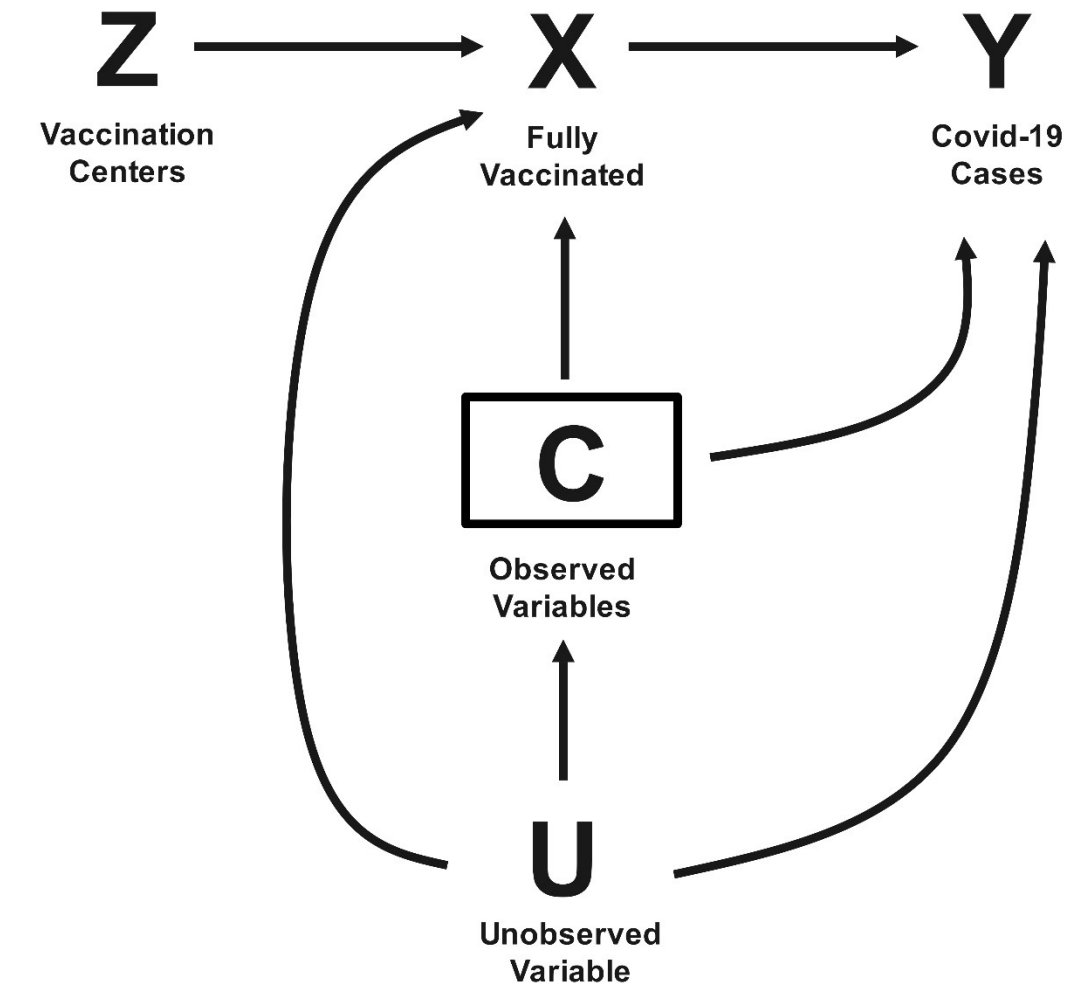
MySejahtera system assigns specific vaccination centers with dates and times

Limited individual choice

Separate facilities for screening and vaccine administration

Robustness checks with two-stage regression

Directed Acyclic Graph (DAG)



Econometric Model – Two-Stage Least Squares (2SLS) Approach

2SLS Approach

↓

1st Stage Regression

Log(Fully Vaccinated) = f (Vaccination Centres, controls)

↓

2nd Stage Regression

Log(COVID-19 Cases) = f (Predicted vaccination, controls)

Controls:
Partially vaccinated rate
% elderly population, married individuals and never-married
Population density, median household income, schools, religion, ethnicity

1 $\text{Log } Yi = \beta \text{ Log } Xi + Ci\gamma + Ui$

2 $\text{Log } Xi = \lambda \text{ Log } Zi + Ci\alpha + Ui$

Results - First Stage Regression

IV Instrument → **Significantly correlated with the number of fully vaccinated individuals**
-0.0287 to -0.0112 ($p < 0.01$)

	Dependent Variable: Log Cases Rate Per 1000							
	OLS				IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Full Vaccination Per 1000	0.565***	-1.495	-0.668	-0.448	-2.618	-12.06*	-10.71**	-11.15**
	(0.155)	(1.848)	(1.788)	(1.898)	(5.006)	(6.754)	(5.381)	(5.428)
Log Partial Vaccination Per 1000		2.071	1.157	0.939		12.59*	11.21**	11.66**
		(1.834)	(1.797)	(1.909)		(6.797)	(5.443)	(5.492)
Log Population Density		0.155***	0.222***	0.227***		0.160***	0.196***	0.187***
		(0.024)	(0.029)	(0.032)		(0.050)	(0.047)	(0.051)
Elderly		-0.005	0.025	0.025		-0.070	-0.035	-0.035
		(0.023)	(0.0219)	(0.0215)		(0.0497)	(0.0433)	(0.0428)
Married		0.033**	0.041*	0.046**		0.0216	0.038	0.041
		(0.017)	(0.022)	(0.023)		(0.019)	(0.027)	(0.028)
Never Married		0.010	0.017*	0.019*		0.001	0.012	0.012
		(0.008)	(0.010)	(0.010)		(0.011)	(0.011)	(0.011)
Log Median Household Income		-0.270***	-0.050	-0.055		-0.570**	-0.373*	-0.391**
		(0.099)	(0.119)	(0.118)		(0.231)	(0.193)	(0.193)
Log School		-0.079	-0.007	-0.016		0.087	0.124	0.131
		(0.07)	(0.056)	(0.058)		(0.128)	(0.103)	(0.108)
Religion	No	No	Yes	Yes	No	No	Yes	Yes
Ethnicity	No	No	No	Yes	No	No	No	Yes
Observations	148	148	148	148	148	148	148	148

Notes: $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Robust z statistics in parenthesis. All regressions include a constant.
Source: Data are taken from 24 February 2021 to 19 October 2022 from Ministry of Health and DOSM

Results - Second Stage Regression

IV Instrument

1% increase in full vaccination per 1,000 individuals

1% increase in partial vaccination per 1,000 individuals

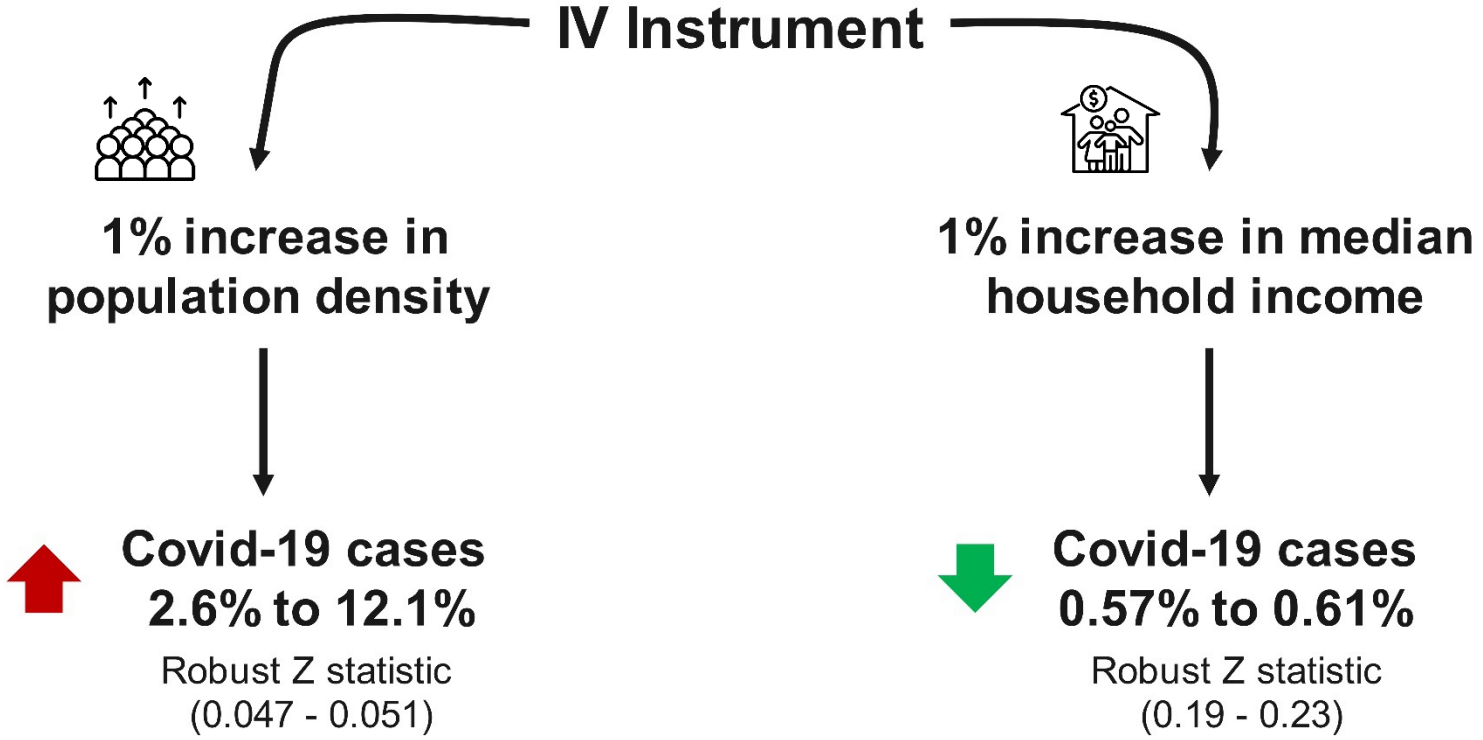
↓ **Covid-19 cases 2.6% to 12.1%**

Robust Z statistic
(5.3 - 6.8)

↑ **Covid-19 cases 11.2% to 12.6%**

Robust Z statistic
(5.4 - 6.8)

Results – Other Findings



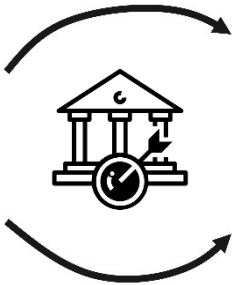
Conclusion

Main Findings

The fully vaccinated population effectively **reduces** the number of COVID-19 cases in Malaysian districts.

The partially vaccinated population highlights a potential **limitation** of single-dose vaccination in curbing viral spread, especially given the prevalence of variants like Delta.

Targeted Policy



Population density is a significant factor contributing to outbreaks.

Higher household median income shows potential protective effects against the virus.