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An observational study of the association between COVID-19 vaccination rates and participation in a vaccine lottery

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Abstract

Objectives
Are financial incentives from entry in a vaccine lottery associated with a higher probability of vaccination for COVID-19?

Design
A cross-sectional study with adjustment for covariates using logistic regression

Setting
October and November 2021, Australia.

Participants
2,375 respondents of the Taking the Pulse of the Nation Survey

Interventions
Participation in the Million Dollar Vaccination Lottery

Primary and secondary outcome measures
The proportion of respondents who had any vaccination, a first dose only, or second dose compared to all other respondents

Results
Those who participated in the lottery were 2.28 times more likely to be vaccinated after the lottery opened on October 1st than those who did not. This was driven by those receiving second doses. Lottery participants were 1.38 times more likely to receive their first dose after October 1st and 2.31 times more likely to receive their second dose after October 1st.

Conclusions
Lottery participation is associated with a higher vaccination rate, with this effect dominated by a higher rate of second doses. There is a smaller insignificant difference for those receiving a first dose, suggesting lotteries may not be as effective at reducing vaccine hesitancy, compared to 'nudging' people to get their second dose more quickly.

Strengths and limitations of this study
- We use a nationally representative sample of individuals.
- We distinguish between the association between lottery participation and first and second doses.
- We adjust for a rich set of individual characteristics associated with vaccination status
- The strong association for second dose vaccinations may reflect some individuals who had already had scheduled their second dose after the lottery opened, potentially leading to an overestimate of the association.

Ethics statement

This study was approved by the University of Melbourne Faculty of Business and Economics & Melbourne Business School Human Ethics Advisory Group (Ref: 2056754.1).

Background

The effectiveness of using financial incentives to increase vaccination rates for the SARS-COV-2 virus is uncertain.[1-3] Vaccination lotteries were established to increase vaccination rates, including across at least 21 states in the United States in 2021. Most notable is the lottery in Ohio run during May-June 2021 with 5 x $1 million prizes over five weeks. Four studies using state-level data on vaccination rates over time, and comparing states with lotteries with those with none, found lotteries were ineffective in increasing vaccination rates.[4-7] Four studies found an increase in vaccination rates[8-11], including one that found increases in vaccination rates in low-income counties in Ohio but not in high-income counties.[9] One study examined the use of financial incentives across 24 states across the U.S., mainly including lotteries, and found no overall impact on vaccination rates.[12]

Our research uses individual-level data to examine the association between vaccination rates and participation in a vaccination lottery held in Australia in October 2021. The Million Dollar Vaccination Lottery (M$V) was open to entries from 1st to 31st of October 2021 for those aged 18 years or over who were Australian residents. Unlike some U.S. lotteries where the whole population was automatically entered the lottery, in M$V, each person entered voluntarily by completing a short webform providing their contact details. At entry, participants could already be fully vaccinated or have had the first vaccination. Proof of vaccination was not required at entry into the lottery though individuals had to tick a box on the webpage stating that they had at least their first dose. If they were chosen to receive a prize (a provisional winner), they were required to show proof of full vaccination in the form of a government-approved electronic vaccination certificate. To claim a prize full vaccination must have occurred before 13th December, or no later than 13th January, depending on the required interval between first and second doses, which may vary across States and be up to 12 weeks. Only one entry per person was allowed.

M$V was funded by an alliance of philanthropic organisations coordinated by the Summer Foundation. The lottery had a $AU 1 million ($US 0.72 million) Grand Prize in cash and a total of 3,100 daily prizes of $AU 1,000, with a total prize pool of $AU 4.1 million. Each entrant was eligible for the Grand Prize draw and the daily draw on the entry date. The daily prizes were in the form of a gift card that could be used at a range of participating stores. The lottery was accompanied by a $AU 3 million marketing campaign led by Sayers that included peak-time TV, radio, and full-page national and regional newspaper advertising, extensive social media advertising, and outdoor media (e.g., electronic posters at bus stops and shopping centres). The campaign targeted culturally and

linguistically diverse audiences and included advertising in languages such as Mandarin, Arabic, Cantonese, and Vietnamese, and areas with high populations of Indigenous people. As the campaign progressed, the targeting became more granular and nuanced in response to the analysis of data regarding the reach of the campaign, competition entrants, and vaccination rates in specific geographic locations throughout Australia. In response to concerns raised on social media about M$V being a scam, the campaign pivoted to engage and profile daily draw winners in paid and to provide social proof about the legitimacy of M$V. When the lottery closed, 2,744,974 Australians had entered, representing 13.7% of the adult population.

The context of the lottery was when Australia was well on its way to meeting vaccination targets. Australia's vaccination program started in March 2021. On the 30th of September, just before the lottery opened, vaccination rates had steadily increased to 77.8% percent of the population over 16 years old with a first dose and 54.2% with a second dose. New South Wales (NSW) and Victoria, the two most populous states, had experienced outbreaks since July 2021 and were under various forms of lockdown at the end of September, including night-time curfews in Victoria, closure of retail businesses and hospitality, and continuing bans on travel. Lockdowns in NSW were more targeted at specific LGAs with high case numbers. All eight states and territories agreed to a national roadmap on the 6th of August, with states individually releasing precise targets of population vaccination rates that were linked to the lifting of restrictions throughout the last quarter of 2021, with some targets being at the time the lottery was open. For example, in Victoria, the targets were 70% of the population aged 16 and over, (reached on 21st October), 80% (reached on 29th October), and 90% of 12+ years (reached on 18th November) with second dose. These targets provided non-financial incentives to get a second dose (referred to as 'fully vaccinated' at the time) as restrictions were eased when targets were met, with restrictions largely non-existent after the 90% target was reached.

The lottery provided the potential to receive financial incentives to encourage receipt of the first dose for those not vaccinated and provided incentives to those with a first dose to schedule a second dose if they had not already done so. Those with a first dose may already have had their second dose scheduled during October given the recommended fixed interval between doses, and so the lottery would not influence this group unless they changed their scheduled appointment to receive their second dose earlier. There were also those with a first dose who had not scheduled their second at the time the lottery opened. Those who already

had their second dose before the lottery opened could still enter the lottery, but their vaccination status would not be affected by the lottery.

Methods

Patient and public involvement statement. There was no patient or public involvement in this study.

Data and participants. The Taking the Pulse of the Nation (TTPN) Survey was used to collect data. This is run by the Melbourne Institute and was administered every week from April 2020 and every two weeks from January 2021. Each wave includes 1,200 respondents, so it is a repeated cross-section. This paper uses data from 2,400 respondents in Waves 44 and 45 conducted in November 2021 after the lottery was closed at the end of October.

Data were collected by a commercial provider using a mixed-mode procedure. For each wave, 400 respondents were interviewed by telephone, and 800 respondents completed a web survey. The survey provider constructed the sampling frame from a diverse set of continuously updated proprietary databases. The survey sampling procedure followed strict quotas for six states and the Australian Capital Territory (ACT). Each wave includes 600 men and 600 women, and the shares of respondents for each state and ACT are proportional to the population of that state or territory. Each survey wave takes up to six days until the gender/state quotas are reached. Waves 44 and 45 were in the field between 1st and 6th November and 15th to 20th November. The raw share of each state/location/gender/age-group strata in the survey sample is not necessarily the same as the share of this stratum in the population. For each survey wave, post-stratification inverse probability weights are calculated provided based on Greater Capital City Statistical Area (GCCSA) or 'Rest of State' for each state using respondents' postcode, age group (18-24, 24-35, 35-44, 45-54, 55-64, 64-75), and gender.

Study design and hypothesis. This is a cross-sectional observational study that examines the association between entering the lottery and the probability of receiving a vaccination after the lottery opened on October 1st. The study design exploits information on the month individuals received their first or second dose of a COVID vaccine which was asked in Waves 44 and 45 after the lottery had closed.

Variables. Participants were asked the following questions during Waves 44 and 45 in November 2021 to determine their vaccination status. *"Are you willing to have the COVID-19 vaccine? (1) Yes, (2) No, (3) Don't Know (4), I have had the first dose of the vaccine only (5), I have had the first and second dose of the vaccine*." If they answered option (4) they were asked the month of their first vaccination. If they answered option (5), they were asked the month of their second vaccination. They were separately asked, *"Did you enter the Million Dollar Vax Lottery? (1) Yes, 2) No.*" The main outcome variable is binary and equal to one for those who reported receiving any vaccination (first or second dose) after the lottery opened in October and is zero for the rest of respondents (including those who remained unvaccinated or those who received their first or second dose before October). In addition, we also separately analysed those who had their first dose after the lottery opened and those who had their second dose after the lottery opened.

TTPN asks a range of questions known to be associated with vaccination status, so these were included as independent variables in the analysis. We include indicators for male, age categories (25-34; 35-44; 45-49; 50-54; 55-64; 65-74; 75+), having a child under 18, income categories (25-50; 50-75; 75 percentile+), education categories (high school graduates; some college; university and above), and categories of the industry relative to the unemployed (agriculture; mining; manufacturing; electricity; construction; wholesale; retail; food services; transport; information media; insurance services; real estate services; professional, scientific and technical services; administrative services; public administration; education; healthcare assistance; arts and recreation services; other). Indicators for states (VIC, QLD, SA, WA, others (ACT, TAS, NT)) and living in a rural area are included. Indicators for financial stress, policy satisfaction (satisfied; not satisfied), voting preferences (liberal or national; labour; greens or democrats) are included, and an indicator for wave 45 (15 - 19, November).

The vaccination rates of individuals could be associated with the vaccination rates of others in their LGA through neighbourhood peer effects, the location of vaccination providers, and other LGA-specific factors. In addition, M$V targeted LGAs with low vaccination rates, and so LGA vaccination rates would be associated with participation in the lottery. We, therefore, merge data on LGA-level vaccination rates using each respondent's postcode of residence.

Statistical analysis. Data are analysed using logistic regression using the outcome variable (vaccinated after October 1st, 2021) and the above covariates as independent variables to adjust for observed differences between those participating in the lottery and those who did not. Separate regressions are conducted for those receiving their first vaccination after October 1st and those receiving their second vaccination after October 1st. Results are reported as odds ratios and marginal effects of the difference in the probability of being vaccinated. We exclude respondents who did not know the month they were vaccinated.

Results

Of 2,400 respondents, 2,375 responded to the vaccination question. A further 13 respondents did not know the month they received their first vaccination, leaving 2,362 for the analysis of receipt of the first dose. At the time survey was completed in November, after the lottery had closed, 59.9% of all respondents had received two doses, 6.1% had only their first, and 22.3% were willing to be vaccinated but had not yet received their first dose, 7% were unwilling to be vaccinated, and 4.7% were unsure.

Table 1: Descriptive Statistics

	Full Sample		In lottery		Not in lottery	
	Mean	Std.	Mean	Std.	Mean	Std.
Proportion receiving any dose after October 1st (n=2,362)	0.252	0.434	0.393	0.489	0.224	0.417
Proportion receiving first dose after October 1st (n=2,362)	0.089	0.285	0.118	0.323	0.083	0.276
Proportion receiving second dose after October 1st (2,375)	0.208	0.406	0.337	0.473	0.181	0.385
Lottery entrant	0.170	0.376	1.000	0.000	0.000	0.000
Male	0.485	0.500	0.415	0.493	0.500	0.500
Age 18 - 24	0.116	0.320	0.098	0.298	0.120	0.325
Age 25 - 34	0.192	0.394	0.184	0.388	0.194	0.396
Age 35 - 44	0.173	0.378	0.188	0.391	0.170	0.375
Age 45 - 49	0.084	0.278	0.105	0.307	0.080	0.271
Age 50 - 54	0.081	0.273	0.127	0.334	0.071	0.258
Age 55 - 64	0.152	0.359	0.192	0.395	0.144	0.351
Age 65 - 74	0.119	0.324	0.085	0.280	0.126	0.332
Age 75 above	0.082	0.275	0.020	0.139	0.095	0.294
Having a child below 18	0.310	0.463	0.321	0.467	0.308	0.462
Not graduated high school/NA	0.162	0.368	0.141	0.348	0.166	0.372
Highschool graduated	0.175	0.380	0.152	0.359	0.179	0.384
Some college	0.307	0.461	0.325	0.469	0.303	0.460
University and above	0.357	0.479	0.383	0.487	0.351	0.478
Income: below 25 percentile	0.188	0.391	0.131	0.338	0.199	0.400
Income: 25 - 50 percentile	0.288	0.453	0.279	0.449	0.290	0.454
Income: 50 - 75 percentile	0.251	0.433	0.252	0.435	0.250	0.433
Income: 75 and above percentile	0.273	0.446	0.338	0.474	0.260	0.439
Industry: agriculture, forestry and fishing	0.014	0.119	0.011	0.105	0.015	0.122
Industry: mining	0.008	0.089	0.011	0.105	0.007	0.085
Industry: manufacturing	0.026	0.159	0.021	0.143	0.027	0.162
Industry: electricity, gas, water and waste service	0.013	0.114	0.003	0.052	0.015	0.123
Industry: construction	0.030	0.172	0.033	0.178	0.030	0.171
Industry: wholesale trade	0.013	0.113	0.018	0.133	0.012	0.109
Industry: retail trade	0.071	0.257	0.092	0.289	0.067	0.250
Industry: accommodation and food services	0.021	0.143	0.014	0.119	0.022	0.147
Industry: transport, postal and warehousing	0.028	0.166	0.009	0.096	0.032	0.177
Industry: media and telecommunication	0.025	0.158	0.026	0.158	0.025	0.158
Industry: financial and insurance services	0.044	0.205	0.028	0.164	0.047	0.212

Industry: rental, hiring and real estate services	0.009	0.093	0.006	0.080	0.009	0.095
Industry: professional, scientific and technical	0.043	0.203	0.045	0.208	0.043	0.202
Industry: administrative and support services	0.019	0.138	0.020	0.142	0.019	0.137
Industry: public administration and safety	0.022	0.146	0.033	0.178	0.019	0.138
Industry: education and training	0.039	0.194	0.053	0.223	0.036	0.187
Industry: health care and social assistance	0.061	0.240	0.082	0.275	0.057	0.232
Industry: arts and recreation services	0.011	0.104	0.016	0.126	0.010	0.099
Industry: other services	0.059	0.236	0.054	0.226	0.060	0.238
Industry: don't know, refused, unemployed	0.443	0.497	0.426	0.495	0.446	0.497
Living in rural	0.316	0.465	0.697	0.460	0.682	0.466
NSW	0.328	0.470	0.269	0.444	0.340	0.474
VIC	0.265	0.442	0.327	0.470	0.253	0.435
QLD	0.203	0.402	0.194	0.396	0.205	0.404
SA	0.071	0.257	0.059	0.235	0.073	0.261
WA	0.102	0.303	0.126	0.333	0.097	0.296
ACT, TAS, NT	0.031	0.174	0.025	0.156	0.033	0.178
Fully Vaccinated rate by LGA	78.472	14.048	79.774	11.593	78.205	14.487
With Financial Stress	0.436	0.496	0.448	0.498	0.433	0.496
Satisfied with policy	0.428	0.495	0.437	0.497	0.426	0.495
Not satisfied with policy	0.251	0.434	0.212	0.409	0.259	0.438
Indifferent with policy	0.321	0.467	0.351	0.478	0.314	0.464
Voting liberal or national	0.342	0.475	0.328	0.470	0.345	0.476
Voting labour	0.324	0.468	0.350	0.477	0.319	0.466
Voting greens or democrats	0.114	0.318	0.089	0.285	0.119	0.324
Voting others/no preference	0.219	0.414	0.233	0.423	0.217	0.412
Wave 44 (1 - 6, Nov 2021)	0.500	0.500	0.466	0.499	0.507	0.500
Wave 45 (15 – 19, Nov 2021)	0.500	0.500	0.534	0.499	0.493	0.500
Number of observations	2,375		439		1,936	

Notes: Numbers are weighted.

Table 1 shows the weighted descriptive statistics of the sample used in the analysis and compares those who participated in the lottery with those who did not. Seventeen percent of respondents participated in the lottery. After the lottery opened on October 1st, 25.2% of respondents received a vaccination (either first or second dose). For those who entered the lottery, 39.3% received a vaccination after the lottery opened on October 1st, compared to 22.4% of those who did not enter the lottery. After the lottery opened, 8.9% of respondents received their first dose. The percentage of those who entered the lottery and who received their first dose after it opened was 11.8%, compared to 8.3% for those who did not enter the lottery. The proportion who received their second dose after the lottery opened was higher at 20.8%. For those who entered the lottery, 33.7% received their second dose after the lottery opened compared to 18.1% of respondents who did not enter the lottery.

Those who participated in the lottery were more likely to be female, slightly more likely to be under 35, more likely to be between 50 and 64 years old, and less likely to be over 65. Those who participated in the lottery were likely to have a higher income. There was also a higher proportion of lottery participants from Victoria.

Table 2: Adjusted and Unadjusted Regressions

	Any dose after October 1st	First dose after October 1st	Second dose after October 1st
Adjusted analysis			
Lottery entrant	2.281***	1.376	2.312***
(Odds Ratio, 95% CI)	(1.734 to 3.002)	(0.911 to 2.078)	(1.741 to 3.070)
Change in probability	0.156***	0.025	0.146***
(95% CI)	(0.100 to 0.211)	(-0.009 to 0.059)	(0.092 to 0.199)
Unadjusted analysis			
Lottery entrant	2.249***	1.472*	2.300***
(Odds Ratio, 95% CI)	(1.732 to 2.919)	(0.990 to 2.190)	(1.756 to 3.012)
Change in probability	0.169***	0.035	0.156
(95% CI)	(0.111 to 0.228)	(-0.004 to 0.074)	(0.100 to 0.212)
Number of observations	2,362	2,362	2,375

Notes: Results are based on logistic regressions and are all weighted. Respondents who serve as a baseline for categorical variables are in the youngest age group (18 - 24), income is below 25 percentile, education below high school, being unemployed or do not know the industry that they are in, living in NSW, without voting preference, and indifferent policy satisfaction. * = p value<0.10; ** = p value<0.05; *** = p value<0.01.

Table 2 presents the results from the unadjusted logistic regressions that include only the lottery dummy variable as an independent variable, and from the adjusted logistic regressions that include all covariates in Table 1 as independent variables (full results in Appendix 1). The differences between the adjusted and unadjusted models are small. Lottery participation is associated with a higher proportion of respondents having any dose after October 1st. Those who entered the lottery were 2.28 times more likely to have a vaccination after October 1st compared to everyone else. This is equivalent to an increase in the probability of a second dose after October 1st of 0.156 (95% CI 0.100 to 0.211: 15.6 percentage points) compared to everyone else. Lottery entry was associated with a 0.025 (95% CI -0.009 to 0.059) increase in the probability of getting the first dose after October 1st, but this was not statistically significant in the adjusted analysis, with the association driven by people getting their second dose.

The full results (Appendix 1) show that males, those in older age groups, those with children under 18, those working in accommodation and food services, public admin and safety, and other services were less likely to receive any vaccine after October 1st: that is they were more likely to have been vaccinated earlier. There is a strong age gradient suggesting that older people were more likely to get vaccinated before October 1st. Those in rental, hiring, and real estate services were more likely to get vaccinated after October 1st compared to those who were unemployed.

Table 3: Association with participation in lottery

	Odds ratio	95% CI	
Male	0.766*	0.583	1.006
Age 25 – 34	1.035	0.641	1.672
Age 35 – 44	1.213	0.740	1.990
Age 45 – 49	1.339	0.764	2.348
Age 50 – 54	1.862**	1.071	3.237
Age 55 – 64	1.340	0.814	2.205
Age 65 – 74	0.553*	0.294	1.040
Age 75 above	0.172***	0.069	0.428
Having a child under 18	0.897	0.658	1.223
HS graduated	0.835	0.524	1.330
Some college	1.058	0.694	1.614
University and above	1.213	0.780	1.887
Income: 25 - 50 percentile	1.365	0.887	2.100
Income: 50 - 75 percentile	1.398	0.881	2.218
Income: 75 percentile and above	1.773**	1.105	2.844
Industry: agriculture, forestry and fishing	0.631	0.234	1.700
Industry: mining	0.854	0.171	4.262
Industry: manufacturing	0.483*	0.209	1.119
Industry: electricity, gas, water and waste services	0.143*	0.019	1.075
Industry: construction and wholesale	0.804	0.423	1.529
Industry: retail trade	1.044	0.649	1.679
Industry: accommodation and food services	0.438*	0.184	1.045
Industry: transport, postal and warehousing	0.203***	0.063	0.652
Industry: media and telecommunication	0.658	0.301	1.436
Industry: financial and insurance services	0.407**	0.175	0.944
Industry: rental, hiring, and real estate services	0.459	0.093	2.262
Industry: professional, scientific and technical	0.672	0.343	1.318
Industry: administrative and support services	0.710	0.315	1.600
Industry: public administration and safety	0.949	0.442	2.038
Industry: education and training	0.803	0.416	1.549
Industry: health care and social assistance	0.850	0.507	1.423
Industry: arts and recreation services	1.354	0.453	4.049
Industry: other services	0.591*	0.338	1.032
Living in rural	1.068	0.810	1.407
VIC	1.717***	1.220	2.418
QLD	1.617**	1.008	2.593
SA	1.406	0.826	2.393
WA	2.092***	1.236	3.541
ACT, TAS, NT	1.177	0.618	2.243
Fully vaccinated rate by LGA	1.016**	1.003	1.029
With financial stress	1.098	0.835	1.443
Satisfied with policy	0.993	0.729	1.353
Not satisfied with policy	0.760	0.540	1.070
Voting liberal or national	1.003	0.699	1.439
Voting labour	1.087	0.773	1.527
Voting greens or democrats	0.735	0.457	1.180
Wave 45 (15 - 19 Nov, 2021)	1.069	0.823	1.388
Constant	0.038	0.011	0.124

Notes: n=2375. Results are based on logistic regressions and are all weighted. Respondents who serve as a baseline for categorical variables are in the youngest age group (18 - 24), income is below 25 percentile, education below high school, being unemployed or do not know the industry that they are in, living in NSW, without voting preference, and indifferent policy satisfaction.

Table 3 examines who is more likely to participate in the lottery. Males were less likely to do so compared to females. Relative to those aged 18-24, respondents aged 50-54 were more likely to be in the lottery, while those older than 65 were less likely to enter. Compared to those in the lowest income quartile, people in the highest income quartile were more likely to enter the lottery. Those working in manufacturing, electricity, gas, water services, accommodation and food services, transport, postal and warehousing, and financial and insurance services were less likely to enter the lottery than those who were unemployed. Respondents in LGAs with higher vaccination rates were more likely to enter the lottery. Compared to those living in NSW, respondents living in Victoria, Queensland, and Western Australia were more likely to enter the lottery.

Discussion

This study finds evidence of a statistically significant association between lottery participation and receipt of vaccination after the lottery opened on October 1st. However, there was no association of lottery entry with having the first dose once the lottery opened, suggesting the lottery did not reduce vaccine hesitancy. The association was driven by those who had received a second dose after October 1st. This group includes those who had already made an appointment before October 1st to receive a second dose after October 1st. This group was still able to enter the lottery but the lottery would not have influenced when they received their second vaccination. This may lead to an overestimate of the effect of lottery participation on vaccination rates. The other group are those who had previously received a first dose sometime before October 1st and decided to schedule their second dose in response to the lottery incentives or had their second dose booked already but had it brought forward. We cannot distinguish between these groups in our data as we did not capture the month of the first dose for those who had a second dose, and so could not measure the interval between first and second doses. The mandated interval between the first and second dose varied across states, which we adjust for in the analysis, and the type of vaccine received.

Distinguishing between the effect of a lottery on first and second doses is important for policy as they imply different objectives and the targeting of policy towards different groups of the population. Policies targeting first doses relatively late in a pandemic are tackling vaccine hesitancy as well as access to vaccines, whilst policies targeting second doses are more about achieving population protection in a timely manner by improving access and 'nudging' people to get their second dose. Lotteries can potentially influence both and the

M$V lottery explicitly targeted LGAs with low vaccination rates and so was more focused on tackling vaccine hesitancy. However, vaccine hesitancy is determined by a complex range of factors that financial incentives do not directly address. Lotteries may be more effective as 'nudges' for those who are already motivated to get vaccinated but have not yet arranged their appointments.

Our research adds to the literature using a unique and representative sample of individuals from Australia during the time when the M$V lottery was open. Previous evidence from the U.S., including several evaluations of the Ohio vaccine lottery, shows mixed results using difference-in-difference study designs. Of five studies that examined first doses[4 7-9 11], three found evidence of an effect of lotteries.[8 9 11] Of two studies that examined second doses[4 5], only one found an effect of the lottery.[5] Two studies[6 10] used the total rate of vaccinations combining first and second doses and one of these found an effect[10].

The Ohio lottery and M$V were designed differently, implemented at different times during the pandemic, and may have had different marketing campaigns and this may influence the results. The whole population of Ohio was eligible to win and many may not have known about the lottery and so were not motivated to get vaccinated. In the U.S. at that time the rate of vaccination was slowing, suggesting a lack of motivation in the population. The M$V lottery, however, required individuals to enter and allowed individuals entry if they had already been fully vaccinated. In addition, October 2021 was a time when vaccination rates were steadily increasing and when vaccinations targets focussing on second doses ('fully' vaccinated) had been set by some states that were linked to the lifting of harsh lockdowns. Generally, the Australian population was more motivated to get vaccinated and the M$V lottery added to this motivation. People who were already fully vaccinated may have interpreted the lottery as a reward for their patience during lockdowns and for their earlier decision to get vaccinated, and for this group therefore the lottery did not influence their decision to get vaccinated.

Our results found that those with higher incomes were more likely to participate in the M$V lottery which is opposite to expectations. Those on lower incomes are more likely to participate in lotteries generally[13 14]. Our result maybe because of the specific context of COVID-19 where a large proportion of the population was or had been in a severe lockdown,

and so the lottery was also perceived as a reward for their patience and for already being vaccinated and that this perception was more widely held by those with higher incomes.

The results also showed that those in LGAs with higher vaccination rates were more likely to enter the lottery compared to LGAs with lower vaccination rates, again suggesting that those who might have already been vaccinated before October 1st were more likely to enter. The M$V marketing campaign targeted LGAs with lower vaccination rates. Our results suggest that targeted marketing to persuade people to enter a vaccine lottery could be less effective in vaccine-hesitant populations where vaccination decisions are determined by a more complex range of factors that influence access, information, and beliefs[15]. Vaccine lotteries could be more effective as 'nudges' for people to get their second dose more quickly.

We do not examine the overall vaccination rate but the timing of when people received their second vaccination, so our numerical results are not comparable to those from other studies that use changes over time in population vaccination rates or the number of vaccines administered. Our data are self-reported and there is a risk of over-reporting of vaccination rates due to social desirability bias. However, this is unlikely as our self-reported rate of second vaccinations of 59.9% in the sample is lower than official data at the time it was collected (77.5% on November 1st and 87% on November 30th). This also raises concerns about the representativeness of our sample. Though our sample is representative of states and territories and uses weights based on location, gender, and age, it is from a commercial panel where respondents might be different from the general population who do not participate in commercial panel surveys in ways we do not observe that might be correlated with lottery participation or vaccine hesitancy. For example, 17% of our sample participated in the M$V lottery compared to the national estimate of 13.7%.

The role of financial incentives to increase vaccination rates remains unclear, with some evidence suggesting that direct cash transfers might be more effective than lotteries[3 13 16 17], but would also be more costly to implement on a population level. Further research should directly compare lotteries and cash transfers with other strategies[16] to increase vaccination uptake and reduce vaccine hesitancy, though such strategies depend on the context and the stage of the pandemic and may interact with other strategies to increase vaccination rates, particularly in vaccine-hesitant populations where other factors are likely to matter more than financial incentives.

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Authors contributions
AS conceived of the study, secured funding, designed the survey questions, contributed to the analysis, wrote and revised the manuscript, and interpreted results. DJ prepared the data and conducted all statistical analyses, contributed to writing and revising the manuscript, and interpreting results.

Conflict of Interests
None declared.

Data sharing statement
Statistical code for the analysis s available from the Dryad repository, DOI: https://doi.org/10.5061/dryad.rv15dv495. TTPN Survey is a proprietary data set and researchers interested in replication need to seek access to the TTPN survey by contacting the Melbourne Institute.

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Appendix

Table A1. Full regression results

	Any dose after October 1st			First dose after October 1st			Second dose after October 1st		
	Odds ratio	95% CI		Odds ratio	95% CI		Odds ratio	95% CI	
Lottery entrant	2.281	1.733	3.002	1.376	0.911	2.078	2.315	1.743	3.073
Male	0.695	0.545	0.885	0.578	0.397	0.841	0.772	0.600	0.994
Age 25 - 34	1.086	0.749	1.574	0.908	0.545	1.514	1.192	0.813	1.746
Age 35 - 44	0.665	0.447	0.991	0.653	0.378	1.127	0.829	0.546	1.258
Age 45 - 49	0.549	0.330	0.911	0.375	0.180	0.783	0.766	0.447	1.313
Age 50 - 54	0.309	0.181	0.528	0.183	0.063	0.531	0.432	0.248	0.753
Age 55 - 64	0.332	0.212	0.518	0.268	0.137	0.522	0.455	0.287	0.720
Age 65 - 74	0.408	0.233	0.716	0.137	0.052	0.359	0.544	0.301	0.981
Age 75 above	0.230	0.102	0.520	0.106	0.022	0.523	0.279	0.116	0.672
Having a child under 18	0.705	0.537	0.925	0.853	0.572	1.273	0.657	0.496	0.871
HS graduated	1.108	0.723	1.697	1.294	0.695	2.410	0.929	0.589	1.464
Some college	0.962	0.656	1.412	1.050	0.600	1.837	0.943	0.632	1.406
University and above	0.955	0.629	1.449	0.928	0.496	1.735	0.946	0.612	1.464
Income: 25 - 50 percentile	1.129	0.766	1.664	1.172	0.678	2.026	1.161	0.765	1.763
Income: 50 - 75 percentile	1.053	0.699	1.587	1.032	0.566	1.883	1.150	0.742	1.781
Income: 75 percentiles and above	1.058	0.666	1.679	1.443	0.763	2.730	0.962	0.591	1.567
Industry: agriculture, forestry and fishing	2.469	0.989	6.162	2.792	0.784	9.941	1.416	0.533	3.765
Industry: mining	3.381	0.933	12.255	5.743	1.696	19.443	0.474	0.083	2.703
Industry: manufacturing	0.918	0.407	2.067	1.022	0.326	3.200	0.853	0.375	1.944
Industry: electricity, gas, water and waste service	0.612	0.175	2.144	1.075	0.231	4.997	0.603	0.156	2.328
Industry: construction and wholesale	1.018	0.599	1.731	0.734	0.310	1.738	1.199	0.690	2.084
Industry: retail trade	1.094	0.712	1.682	0.732	0.371	1.446	1.038	0.667	1.614
Industry: accommodation and food services	0.366	0.159	0.839	0.451	0.158	1.284	0.494	0.214	1.138
Industry: transport, postal and warehousing	1.666	0.816	3.401	2.324	0.885	6.104	1.280	0.631	2.598
Industry: media and telecommunication	1.549	0.770	3.114	0.894	0.339	2.356	1.808	0.889	3.676
Industry: financial and insurance services	1.067	0.567	2.008	1.019	0.363	2.859	0.885	0.447	1.753
Industry: rental, hiring and real estate services	2.947	1.187	7.317	6.221	1.906	20.305	1.040	0.333	3.250
Industry: professional, scientific and technical	1.170	0.655	2.090	1.169	0.485	2.818	1.133	0.630	2.039
Industry: administrative and support services	0.849	0.425	1.696	1.124	0.450	2.805	0.989	0.493	1.986
Industry: public administration and safety	0.433	0.186	1.006	0.299	0.075	1.199	0.554	0.239	1.284
Industry: education and training	1.412	0.820	2.433	0.519	0.210	1.283	1.636	0.941	2.844
Industry: health care and social assistance	0.785	0.468	1.317	0.736	0.339	1.600	0.887	0.508	1.549

Industry: arts and recreation services	1.172	0.386	3.554	1.061	0.240	4.688	0.944	0.317	2.812
Industry: other services	0.540	0.312	0.932	0.770	0.330	1.797	0.583	0.329	1.033
Living in rural	1.244	0.957	1.618	1.305	0.899	1.894	1.198	0.907	1.583
VIC	1.325	0.987	1.778	2.521	1.544	4.118	1.060	0.787	1.427
QLD	0.905	0.598	1.371	2.849	1.557	5.213	0.596	0.385	0.923
SA	0.891	0.550	1.443	3.842	1.984	7.440	0.544	0.327	0.904
WA	1.282	0.795	2.068	3.184	1.628	6.226	0.824	0.497	1.365
ACT, TAS, NT	0.671	0.363	1.242	2.472	0.971	6.290	0.536	0.277	1.038
Fully vaccinated rate by LGA	0.999	0.987	1.011	1.010	0.995	1.025	0.996	0.985	1.008
With financial stress	0.871	0.674	1.126	0.802	0.542	1.188	0.942	0.723	1.227
Satisfied with policy	0.857	0.644	1.140	1.116	0.716	1.740	0.702	0.523	0.942
Not satisfied with policy	1.006	0.740	1.369	0.900	0.576	1.406	0.965	0.700	1.331
Voting liberal or national	1.071	0.749	1.531	0.947	0.539	1.666	1.236	0.849	1.801
Voting labour	1.353	0.973	1.880	1.190	0.734	1.929	1.402	0.989	1.987
Voting greens or democrats	1.137	0.763	1.697	1.122	0.634	1.986	1.395	0.922	2.110
wave 45 (15 - 19 Nov, 2021)	1.293	1.012	1.650	1.903	1.336	2.712	1.203	0.933	1.552
Constant	0.486	0.152	1.554	0.027	0.006	0.124	0.497	0.151	1.641

Notes: Results are based on logit regressions and are all weighted. Respondents who serve as a baseline are as follows: in the youngest age group (18 - 24), income is below 25 percentiles, education below high school, being unemployed or do not know the industry that they are in, living in NSW, without voting preference, and indifferent policy satisfaction. * = p value<0.10; ** = p value<0.05; *** = p value<0.01.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	1
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	5
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	5
		(*c*) Explain how missing data were addressed	N/A
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	5
		(*e*) Describe any sensitivity analyses	5-6

Continued next page

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	7
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	N/A
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	N/A
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	7-8
		Cross-sectional study—Report numbers of outcome events or summary measures	7-8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-8
		(*b*) Report category boundaries when continuous variables were categorized	7-8
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8
Discussion			
Key results	18	Summarise key results with reference to study objectives	8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	8-9
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8-10
Generalisability	21	Discuss the generalisability (external validity) of the study results	8-11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

An observational study of the association between COVID-19 vaccination rates and entry into the Australian 'Million Dollar Vax' competition

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An observational study of the association between COVID-19 vaccination rates and entry into the Australian 'Million Dollar Vax' competition

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Melbourne Institute: Applied Economic and Social Research
The University of Melbourne

Abstract

Objectives

To examine the association between financial incentives from entry into a vaccine competition with the probability of vaccination for COVID-19.

Design

A cross-sectional study with adjustment for covariates using logistic regression

Setting

October and November 2021, Australia.

Participants

2,375 respondents of the Taking the Pulse of the Nation Survey

Primary and secondary outcome measures

The proportion of respondents who had any vaccination, a first dose only, or second dose after the competition opened compared to all other respondents

Results

Those who entered the competition were 2.27 (95% CI 1.73 to 2.99) times more likely to be vaccinated after the competition opened on October 1st than those who did not—an increase in the probability of having any dose of 0.16 (95 % CI 0.10 to 0.21) percentage points. This increase was mostly driven by those receiving second doses. Entrants were 2.39 (95% CI 1.80 to 3.17) times more likely to receive their second dose after the competition opened.

Conclusions

Those who entered the Million Dollar Vax competition were associated with a higher vaccination rate compared to those who did not, with this effect dominated by those receiving second doses.

Strengths and limitations of this study

- The strong association for second dose vaccinations may reflect some individuals who had already scheduled their second dose after the competition opened, potentially leading to an overestimate of the association.
- We use a nationally representative sample of individuals.
- We distinguish between the association between competition entry and first and second doses.
- We adjust for a rich set of individual characteristics associated with vaccination status

Ethics statement

This study was approved by the University of Melbourne Faculty of Business and Economics & Melbourne Business School Human Ethics Advisory Group (Ref: 2056754.1).

Background

The effectiveness of using financial incentives to increase vaccination rates for the SARS-COV-2 virus is uncertain.[1],[2],[3] One form of financial incentive has been the entry into vaccination competitions where participants are eligible for large randomly-drawn cash prizes. These have also been referred to as lotteries but unlike lotteries, they do not require cash payment on entry and are not a form of profit-driven gambling. Financial incentives have been used before to encourage childhood immunisation, but not in the form of competitions with cash prizes. Such competitions were established in 2021 to increase vaccination rates for COVID-19, mostly in the United States. For example, the competition in Ohio was run from May to June 2021 with 5 x $1 million prizes over five weeks.

However, the evidence on the effect of such competitions on vaccination rates has been mixed. Four studies using state-level data on vaccination rates over time, and comparing states with vaccination competitions with those with none, found they were ineffective in increasing vaccination rates.[4],[5],[6],[7] Four studies found an increase in vaccination rates[8], [9], [10], [11], including one that found increases in vaccination rates in low-income counties in Ohio but not in high-income counties.[9] One study examined the use of financial incentives across 24 states across the U.S., mainly including vaccination competitions, and found no overall impact on vaccination rates.[12] The reason for these mixed results is unclear as all used aggregate state-level data on changes in vaccination rates over time through each used slightly different methodologies.

Unlike most of this previous work, the aim of this research is to conduct a more granular analysis using individual-level data to examine the association between an individual's decision to get vaccinated and financial incentives. The Million Dollar Vaccination Campaign (M$V) was open to entries from 1st to 31st of October 2021 for those aged 18 years or over who were Australian residents. This was accompanied by a significant national marketing campaign that specifically targeted local areas with low vaccination rates and with populations finding it difficult to access vaccinations. If an entrant was chosen to receive a prize, they were required to show proof of two-dose vaccination in the form of a government-approved electronic vaccination certificate.

M$V was funded by an alliance of philanthropic organisations coordinated by the Summer Foundation. The competition was designed to increase the rate of full (two-dose) vaccinations in the context of meeting national vaccination targets that would trigger the end of harsh lockdowns in the two most populous states, New South Wales and Victoria. The objective was to speed up the rate of vaccination amongst those who intended to get

vaccinated but had not yet done so. This was intended to reduce hospitalisations and ongoing economic costs of lockdowns. Australia's vaccination program started in March 2021. The Therapeutic Goods Administrative approved three vaccines for Australians' use in 2021: Pfizer, AstraZeneca, and Moderna, each requiring two doses for 'full vaccination'. On the 30th of September, just before the competition opened, vaccination rates had steadily increased to 77.8% percent of the population over 16 years old with a first dose and 54.2% with a second dose. New South Wales (NSW) and Victoria, the two most populous states, had experienced outbreaks since July 2021 and were under various forms of lockdown at the end of September, including night-time curfews in Victoria, closure of retail businesses and hospitality, and continuing bans on travel. Lockdowns in NSW were more targeted at specific Local Government Areas (LGAs) with high case numbers. All eight states and territories agreed to a national roadmap on 6th August 2021, with states individually releasing precise targets of population vaccination rates that were linked to the lifting of restrictions throughout the last quarter of 2021, with some target dates at the time the competition was open. For example, in Victoria, the targets were 70% of the population aged 16 and over, (reached on 21st October), 80% (reached on 29th October), and 90% of 12+ years (reached on 18th November) with a second dose. These targets provided non-financial incentives to get a second dose (referred to as fully vaccinated at the time) as restrictions were eased when targets were met, with restrictions largely non-existent after the 90% target was reached.

The competition provided the potential to receive financial incentives to encourage receipt of the first dose for those not vaccinated and provided incentives to those with a first dose to schedule a second dose if they had not already done so. The interval between the first and second doses at the time depended on the vaccine: 4-8 weeks for Astra Zeneca during an outbreak (up to 12 weeks with no outbreak) and 3-6 weeks for Pfizer from July 2021.[13] Those with a first dose may already have had their second dose scheduled during October given the recommended fixed interval between doses, and so the incentives would not influence this group unless they changed their scheduled appointment to receive their second dose earlier or were persuaded not to delay their appointment. Those who already had their second dose before the competition opened could still enter, but their vaccination status would not be affected by the competition.

Method

Patient and public involvement statement. There was no patient or public involvement in the research.

Data and participants. The Taking the Pulse of the Nation (TTPN) Survey was run by the Melbourne Institute and was administered every week from April 2020 and every two weeks from January 2021. Each wave included 1,200 different respondents and so is a repeated cross-section design. The analysis used data from 2,400 respondents in Waves 44 and 45 conducted in November 2021 after the competition was closed at the end of October. Of 2,400 respondents, 2,375 responded to the vaccination question. A further 13 respondents did not know the month they received their first vaccination, leaving 2,362 for our analysis as a final sample.

The TTPN Survey dataset was collected by a commercial provider using a mixed-mode procedure. TTPN was designed to track changes in the economic and social well-being of Australians during the pandemic. For each wave, 400 respondents were interviewed by telephone, and 800 respondents completed a web survey. The survey provider constructed the sampling frame from a diverse set of continuously updated proprietary databases. The survey sampling procedure followed strict quotas for six states and the Australian Capital Territory (ACT). Each wave included 600 men and 600 women, and the shares of respondents for each state and ACT are proportional to the population of that state or territory. Data collection for each survey wave took up to six days to collect until the gender/state quotas are reached. These data have been extensively used in previous research about COVID-19 including Australian's hesitancy to get vaccinated, vaccine choice, border re-opening decisions, and responses towards workplace vaccination and testing mandate.[14], [15], [16], [17]

The raw share of each state/location/gender/age-group strata in the survey sample was not necessarily the same as the share of this stratum in the population. For each survey wave, post-stratification inverse probability weights were calculated based on Greater Capital City Statistical Area (GCCSA) or 'Rest of State' for each state using respondents' postcode, age group (18-24, 24-35, 35-44, 45-54, 55-64, 64-75), and gender. The populations of each stratum are calculated based on the latest ABS estimated resident population projections from the 2016 Census. These weights were used in all analyses.

Study design and hypothesis. Using data from a cross-sectional survey, the main hypothesis is whether there is an association between competition entry and vaccination after September 30th when the competition opened. We test if the proportion of those vaccinated after September 30th (which defines our dependent variable) is different for those who entered the competition compared to those who did not. Unlike some U.S. lotteries where the whole population was automatically entered, each person entered the M$V voluntarily by

completing a short webform providing their contact details. Proof of vaccination was not required at entry though individuals had to tick a box on the webpage stating that they had at least their first dose. Those who had already had their second dose before the competition opened could enter. If they were chosen to receive a prize (a provisional winner), they were required to show proof of full vaccination (interpreted at the time as two doses) in the form of a government-approved electronic vaccination certificate. To claim a prize full (two-dose) vaccination must have occurred before 13th December, or no later than 13th January, depending on the required interval between first and second doses, which may vary across States and be up to 12 weeks. Only one entry per person was allowed.

The competition had a $AU 1 million ($US 0.72 million) Grand Prize in cash and a total of 3,100 daily prizes of $AU 1,000, with a total prize pool of $AU 4.1 million. Each entrant was eligible for the Grand Prize draw and the daily draw on the entry date. The daily prizes were in the form of a gift card that could be used at a range of participating stores. The lottery was accompanied by a $AU 3 million marketing campaign led by Sayers that included peak-time TV, radio, and full-page national and regional newspaper advertising, extensive social media advertising, and outdoor media. The campaign targeted culturally and linguistically diverse audiences and included advertising in languages such as Mandarin, Arabic, and Vietnamese, and areas with high populations of Indigenous people. As the campaign progressed, the targeting became more granular and nuanced in response to the analysis of data regarding the reach of the campaign, competition entrants, and vaccination rates in specific geographic locations throughout Australia. In response to concerns raised on social media about M$V being a scam, the campaign pivoted to engage and profile daily draw winners and to provide social proof about the legitimacy of M$V. When the competition closed, 2,744,974 Australians had entered, representing 13.7% of the adult population. The study design exploited information on the month individuals received their first or second dose of a COVID vaccine which was asked in Waves 44 and 45 after the competition had closed.

Variables. Participants were asked the following questions during Waves 44 and 45 in November 2021 to determine their vaccination status. *"Are you willing to have the COVID-19 vaccine? (1) Yes, (2) No, (3) Don't Know (4), I have had the first dose of the vaccine only (5), I have had the first and second dose of the vaccine*." If they answered option (4) they were asked the month of their first vaccination. If they answered option (5), they were asked the month of their first and second vaccination. They were separately asked, *"Did you enter*

the Million Dollar Vax Lottery? (1) Yes, 2) No." which is used to define the main independent variable of competition entry.

The main outcome variable is defined according to the timing of each individual's vaccination and is equal to one for those who reported receiving any vaccination (first or second dose) after the competition opened in October and is zero for the rest of the respondents (including those who remained unvaccinated or those who received their first or second dose before October). In addition, we separately analysed those who had their first dose after the competition opened and those who had their second dose after the competition opened. The denominator includes the rest of the sample, as we want to compare the number vaccinated after the competition opened with the rest of the population. The denominator, therefore, includes those who had any dose before September 30th, as well as those who remained unvaccinated throughout. The unvaccinated are a key part of the denominator as this group could potentially have changed their decision in response to the lottery.

TTPN asked a range of questions known to be associated with vaccination status, so these were included as independent variables in the analysis. We included indicators for male, age categories (aged 25-34; aged 35-44; aged 45-49; aged 50-54; aged55-64; aged 65-74; 75+), having a child under 18, income categories (25-50 percentile; 50-75 percentile; 75 percentile+; refused to report), education categories (high school graduates; some college; university and above), and categories of the industry relative to the unemployed (agriculture; mining; manufacturing; electricity; construction; wholesale; retail; food services; transport; information media; insurance services; real estate services; professional, scientific and technical services; administrative services; public administration; education; healthcare assistance; arts and recreation services; other). These categories are defined using 2006 Australian and New Zealand Standard Industry Classification from the Australian Bureau of Statistics. Indicators for the states of residence and living in a rural area were included. Indicators for financial stress, policy satisfaction (satisfied; not satisfied), voting preferences (liberal or national; labour; greens or democrats) were included, and an indicator for wave 45 (15 - 19, November) was included.

The vaccination rates of individuals could be associated with the vaccination rates of others in their LGA through neighbourhood peer effects, the location of vaccination providers, and other LGA-specific factors. In addition, M$V targeted LGAs with low vaccination rates, and so LGA vaccination rates would be associated with the competition entry. We, therefore, merged data on LGA-level vaccination rates using each respondent's postcode of residence.

Statistical analysis. Data were analysed using logistic regression with aforementioned covariates as independent variables to adjust for observed differences between those participating in the competition and those who did not. We chose a logistic model to estimate the probability of receiving a vaccine if the respondent entered the lottery. Separate regressions were conducted for those receiving their first vaccination after September 30th and those receiving their second vaccination after September 30th. Results were reported as odds ratios and differences in predicted probabilities of being vaccinated, with 95% confidence intervals.

Results

Descriptive statistics of our final sample. At the time the survey was completed in November after entry had closed, 60.4% of all respondents had received two doses, and 6.1% had only their first. Among those who had not yet received their first dose, 65.7% were willing to be vaccinated, 21.8% were unwilling to be vaccinated, and 12.4% were unsure. In Appendix Table 1, we have included the unweighted number of respondents in each of the categories of vaccination timing and competition entry.

Table 1: Descriptive Statistics

	Full Sample		Entrant		Non-entrant	
	Mean	Std.	Mean	Std.	Mean	Std
Proportion receiving any dose after September 30th	0.252	0.434	0.393	0.489	0.224	0.417
Proportion receiving first dose after September 30th	0.088	0.283	0.115	0.320	0.082	0.275
Proportion receiving second dose after September 30th	0.209	0.407	0.343	0.475	0.182	0.386
Competition entrant	0.169	0.375	1.000	0.000	0.000	0.000
Male	0.485	0.500	0.412	0.493	0.500	0.500
Age 18 - 24	0.116	0.321	0.099	0.299	0.120	0.325
Age 25 - 34	0.192	0.394	0.182	0.386	0.194	0.396
Age 35 - 44	0.173	0.378	0.189	0.392	0.169	0.375
Age 45 - 49	0.084	0.277	0.104	0.305	0.080	0.271
Age 50 - 54	0.081	0.273	0.129	0.335	0.071	0.257
Age 55 - 64	0.153	0.360	0.194	0.396	0.144	0.351
Age 65 - 74	0.120	0.325	0.086	0.281	0.126	0.332
Age 75 and above	0.082	0.274	0.017	0.131	0.095	0.293
Having a child below 18	0.311	0.463	0.321	0.467	0.309	0.462
Not graduated high school/NA	0.161	0.368	0.140	0.347	0.166	0.372
High school graduated	0.173	0.378	0.147	0.355	0.178	0.383
Some college	0.308	0.462	0.327	0.470	0.304	0.460
University and above	0.357	0.479	0.386	0.487	0.352	0.478
Income: below 25 percentile	0.188	0.391	0.132	0.339	0.199	0.399
Income: 25 - 50 percentile	0.288	0.453	0.281	0.450	0.290	0.454
Income: 50 - 75 percentile	0.251	0.434	0.250	0.434	0.251	0.434
Income: 75 and above percentile	0.199	0.400	0.235	0.425	0.192	0.394

Income: refused	0.074	0.262	0.101	0.302	0.068	0.253
Industry: agriculture, forestry and fishing	0.014	0.119	0.011	0.105	0.015	0.122
Industry: mining	0.008	0.089	0.011	0.105	0.007	0.085
Industry: manufacturing	0.026	0.159	0.021	0.144	0.027	0.162
Industry: electricity, gas, water service	0.013	0.114	0.003	0.052	0.015	0.123
Industry: construction and wholesale	0.043	0.202	0.051	0.220	0.041	0.198
Industry: retail trade	0.072	0.258	0.093	0.291	0.067	0.250
Industry: accommodation and food	0.021	0.143	0.014	0.119	0.022	0.148
Industry: transport and warehousing	0.029	0.167	0.009	0.096	0.032	0.177
Industry: media and telecommunication	0.026	0.158	0.026	0.159	0.026	0.158
Industry: financial and insurance services	0.044	0.205	0.028	0.164	0.047	0.212
Industry: rental, hiring and real estate	0.009	0.093	0.007	0.080	0.009	0.095
Industry: professional and scientific	0.043	0.203	0.045	0.208	0.043	0.202
Industry: administrative and support	0.019	0.138	0.021	0.142	0.019	0.137
Industry: public administration and safety	0.022	0.146	0.033	0.178	0.020	0.138
Industry: education and training	0.039	0.194	0.053	0.224	0.036	0.187
Industry: health care and social assistance	0.061	0.239	0.079	0.271	0.057	0.232
Industry: arts and recreation services	0.011	0.105	0.016	0.127	0.010	0.100
Industry: other services	0.059	0.235	0.054	0.226	0.060	0.237
Industry: refused/don't know/not in the labor force	0.442	0.497	0.424	0.495	0.446	0.497
Living in rural	0.316	0.465	0.306	0.461	0.318	0.466
NSW	0.329	0.470	0.271	0.445	0.341	0.474
VIC	0.263	0.441	0.324	0.468	0.251	0.434
QLD	0.204	0.403	0.196	0.397	0.205	0.404
SA	0.070	0.255	0.057	0.232	0.073	0.260
WA	0.102	0.303	0.127	0.334	0.097	0.296
ACT, TAS, NT	0.031	0.174	0.025	0.157	0.033	0.178
Fully Vaccinated rate by LGA	78.420	14.000	79.794	11.624	78.166	14.424
With Financial Stress	0.436	0.496	0.447	0.498	0.434	0.496
Satisfied with policy	0.428	0.495	0.435	0.496	0.427	0.495
Not satisfied with policy	0.252	0.434	0.211	0.409	0.260	0.439
Indifferent with policy	0.320	0.467	0.354	0.479	0.313	0.464
Voting liberal or national	0.342	0.475	0.329	0.470	0.345	0.476
Voting labour	0.324	0.468	0.350	0.478	0.319	0.466
Voting greens or democrats	0.114	0.318	0.086	0.281	0.120	0.325
Voting others/no preference	0.219	0.414	0.235	0.424	0.216	0.412
Wave 44 (1 - 6, Nov 2021)	0.500	0.500	0.465	0.499	0.507	0.500
Wave 45 (15 – 19, Nov 2021)	0.500	0.500	0.535	0.499	0.493	0.500
Number of observations	2,362		436		1,926	

Note: Data are weighted

Table 1 shows the weighted descriptive statistics of the sample used in the analysis and compares those who participated in the competition with those who did not. Seventeen percent of respondents participated in the competition. After the competition opened on October 1st, 25.2% of respondents received a vaccination. Of those who entered the lottery, 39.3% received a vaccination after the competition opened on October 1st, compared to 22.4% of those who did not enter. After the competition opened, 8.8% of respondents received their first dose. The percentage of those who entered the competition and who received their first dose after it opened was 11.5%, compared to 8.2% for those who did not enter. The proportion who received their second dose after the competition opened was higher at 20.9%. Of those who entered the competition, 34.3% received their second dose after the competition opened compared to 18.2% of respondents who did not enter.

Those who chose to enter the competition were more likely to be female, more likely to be between 50 and 64 years old, and less likely to be over 65. Those who entered were likely to have a higher income. There was also a higher proportion of entrants in Victoria.

Regression results for the association of the competition entrant and vaccination take-up

Table 2 presents the results from the unadjusted logistic regressions that include only the dummy variable (entrants vs non-entrants) as an independent variable, and from the adjusted logistic regressions that include all covariates in Table 1 as independent variables. The differences between the adjusted and unadjusted models are small. Competition entry is associated with a higher proportion of respondents having any dose after September 30th. Those who entered were 2.27 times more likely to have a vaccination after September 30th compared to everyone else. This is equivalent to an increase in the probability of having any dose of 0.155 (95% CI 0.100 to 0.210) compared to everyone else. Entry was associated with a 0.022 (95% CI -0.011 to 0.056) increase in the probability of getting the first dose after September 30th, but this was not statistically significant in the adjusted analysis, with the association driven by people getting their second dose. Those who entered were 2.39 times more likely to have a second dose after September 30th compared to everyone else. This is equivalent to an increase in the probability of a second dose after September 30th of 0.152 (95% CI 0.098 to 0.206) compared to everyone else.

Table 2: Adjusted and Unadjusted Regressions

	Any dose after September 30th	First dose after September 30th	Second dose after September 30th
Adjusted analysis			
Entrant vs. non-entrant (Odds Ratio, 95% CI)	2.274*** (1.727 to 2.994)	1.341 (0.884 to 2.033)	2.389*** (1.800 to 3.169)
Change in probability (95% CI)	0.155*** (0.100 to 0.210)	0.022 (-0.011 to 0.056)	0.152*** (0.098 to 0.206)
Unadjusted analysis			
Entrant vs. non-entrant (Odds Ratio, 95% CI)	2.249*** (1.732 to 2.919)	1.451* (0.971 to 2.169)	2.351*** (1.795 to 3.080)
Change in probability (95% CI)	0.169*** (0.111 to 0.228)	0.033 (-0.006 to 0.072)	0.161 (0.105 to 0.217)
Number of observations	2,362	2,362	2,362

Notes: Results are based on logistic regressions and are all weighted. Respondents who serve as a baseline for categorical variables are in the youngest age group (18 - 24), income is below 25 percentile, education below high school, being unemployed or do not know the industry that they are in, living in NSW, without voting preference, and indifferent policy satisfaction. Full results are available in Appendix Table 2. * = p value<0.10; ** = p value<0.05; *** = p value<0.01.

Appendix Table 2 shows that males, those in older age groups, those with children under 18, those working in accommodation and food services, public admin and safety, and other services were less likely to receive any vaccine after September 30th: that is they were more likely to have been vaccinated earlier. There is a strong age gradient suggesting that older people were more likely to get vaccinated before October 1st. Those in rental, hiring, and real estate services were more likely to get vaccinated after September 30th compared to those who were out of the labour force.

Characteristics for those who enter the competition Table 3 examines who is more likely to enter the competition. Males were less likely to do so compared to females. Relative to those aged 18-24, respondents aged 50-54 were more likely to enter, while those older than 65 were less likely to enter. Compared to those in the lowest income quartile, people in the highest income quartile were more likely to enter. Those working in manufacturing, electricity, gas, water services, accommodation and food services, transport, postal and warehousing, and financial and insurance services were less likely to enter than those who were unemployed. Respondents in LGAs with higher vaccination rates were more likely to enter. Compared to those living in NSW, respondents living in Victoria, Queensland, and Western Australia were more likely to enter M$V.

Table 3: Association with entry into M$V (n=2,362)

	Odds ratio	95% CI	
Male	0.756**	0.574	0.994
Age 25 – 34	1.007	0.624	1.624
Age 35 – 44	1.230	0.750	2.019
Age 45 – 49	1.294	0.736	2.274
Age 50 – 54	1.860**	1.070	3.235
Age 55 – 64	1.316	0.799	2.167
Age 65 – 74	0.534*	0.285	1.003
Age 75 above	0.145***	0.055	0.381
Having a child under 18	0.891	0.652	1.216
High school graduated	0.816	0.509	1.309
Some college	1.078	0.705	1.648
University and above	1.280	0.821	1.994
Income: 25 - 50 percentile	1.339	0.871	2.060
Income: 50 - 75 percentile	1.317	0.827	2.097
Income: 75 percentile and above	1.531	0.913	2.568
Income: refused	1.987**	1.123	3.515
Industry: agriculture, forestry and fishing	0.647	0.237	1.765
Industry: mining	0.917	0.184	4.581
Industry: manufacturing	0.529	0.227	1.233
Industry: electricity, gas, water and waste services	0.151*	0.020	1.153
Industry: construction and wholesale	0.885	0.465	1.685
Industry: retail trade	1.085	0.674	1.746
Industry: accommodation and food services	0.448*	0.187	1.076

Industry: transport, postal and warehousing	0.212***	0.066	0.682
Industry: media and telecommunication	0.699	0.319	1.531
Industry: financial and insurance services	0.430	0.185	1.002
Industry: rental, hiring, and real estate services	0.487	0.098	2.417
Industry: professional, scientific and technical	0.700	0.356	1.376
Industry: administrative and support services	0.742	0.331	1.667
Industry: public administration and safety	0.997	0.460	2.161
Industry: education and training	0.839	0.434	1.623
Industry: health care and social assistance	0.830	0.495	1.391
Industry: arts and recreation services	1.390	0.469	4.121
Industry: other services	0.625*	0.357	1.094
Living in rural	1.095	0.830	1.445
VIC	1.703***	1.208	2.401
QLD	1.668**	1.038	2.680
SA	1.363	0.797	2.330
WA	2.170***	1.277	3.685
ACT, TAS, NT	1.192	0.620	2.293
Fully vaccinated rate by LGA	1.017***	1.004	1.030
With financial stress	1.101	0.836	1.450
Satisfied with policy	0.973	0.715	1.326
Not satisfied with policy	0.744*	0.528	1.049
Voting liberal or national	1.032	0.719	1.482
Voting labour	1.112	0.790	1.564
Voting greens or democrats	0.712	0.441	1.149
Wave 45 (15 - 19 Nov, 2021)	1.055	0.812	1.371
Constant	0.034***	0.010	0.116

Notes: Results are based on logistic regressions and the estimates are all weighted. Respondents who serve as a baseline for categorical variables are in the youngest age group (18-24), income is below 25 percentile, education below high school, being unemployed or do not know the industry that they are in, living in NSW, without voting preference, and indifferent policy satisfaction. * = p value<0.10; ** = p value<0.05; *** = p value<0.01.

Discussion

This study finds evidence of a statistically significant association between entry into the M$V competition and receipt of vaccination after the competition opened on October 1st. The association was driven by those who had received a second dose after September 30th. Those who received their second dose after the competition opened included those who had previously received the first dose sometime before October 1st and decided to schedule their second dose in response to the financial incentives. Some in this group could have brought their appointment forward or were persuaded not to delay their appointment any further. However, others in this group would not have been influenced by financial incentives if their second appointment had already been booked. This could lead to an overestimate of the effect of competition entry participation on vaccination rates.

Distinguishing between the effect of financial incentives on first and second doses is important for a policy as they imply different objectives and the targeting of policy towards different groups of the population. M$V aimed to encourage the population to achieve second-dose vaccination targets more quickly than would otherwise have happened. M$V was therefore focused on individuals who are already motivated. It is not surprising that the

competition was not associated with an increase in first doses given the more complex range of factors influencing vaccine hesitancy.

Our research adds to the literature using a unique and representative sample of individuals from Australia when the M$V competition was open. Previous evidence from the U.S., including several evaluations of the Ohio vaccine incentives, shows mixed results using difference-in-difference study designs. Of five studies that examined first doses[4] [7] [8] [9] [11], three found evidence of an effect of incentives. [8] [9] [11] Of two studies that examined second doses [4] [5], only one found an effect.[5] Two studies[6] [10] used the total rate of vaccinations combining first and second doses and one of these found an effect[10].

The Ohio incentives and M$V were designed differently, implemented at different times during the pandemic, and may have had different marketing campaigns and this may influence the results. The whole population of Ohio was eligible to win whereas the M$V competition required individuals to enter. In the U.S. at that time the rate of vaccination was slowing, suggesting a lack of motivation in the population. In addition, October 2021 was a time when vaccination rates were steadily increasing and when vaccination targets focussing on second doses had been set by some states that were linked to the lifting of harsh lockdowns. Generally, the Australian population was more motivated to get vaccinated and the M$V competition added to this motivation. People who were already fully vaccinated may have interpreted the competition as a reward for their patience during lockdowns and for their earlier decision to get vaccinated, and for this group therefore the competition did not influence their decision to get vaccinated.

Our results found that those with higher incomes were more likely to participate in the M$V competition. Though the literature on lotteries suggests those on lower incomes are more likely to enter, recall that vaccination competitions are not lotteries as they do not involve gambling. [18][19] The financial incentives offered through entry into M$V were likely to have been perceived as a reward for getting vaccinated and this perception may have been more widely held by those with higher incomes. The results also showed that those in LGAs with higher vaccination rates were more likely to enter the competition compared to LGAs with lower vaccination rates, suggesting that those who might have already been vaccinated before October 1st were more likely to enter. The M$V marketing campaign targeted LGAs with lower vaccination rates and so assumed the campaign would be more effective in these LGAs. Our results suggest that targeted marketing to persuade people to enter a vaccine competition could be less effective in more vaccine-hesitant populations where vaccination decisions are determined by a more complex range of factors that influence access,

information, and beliefs.[20] In line with the objectives of M$V, vaccine competitions are more effective as 'nudges' for people to get their second dose more quickly.

We do not examine the overall vaccination rate but the timing of when people received their second vaccination, so our numerical results are not comparable to those from other studies that use changes over time in population vaccination rates or the number of vaccines administered. Our data are self-reported and there is a risk of over-reporting of vaccination rates due to social desirability bias. However, this is unlikely as our self-reported rate of second vaccinations of 59.9% in the sample is lower than official data at the time it was collected (77.5% on November 1st and 87% on November 30th). This also raises concerns about the representativeness of our sample. Though our sample is representative of states and territories and uses weights based on location, gender, and age, it is from a commercial panel where respondents might be different from the general population who do not participate in commercial panel surveys in ways we do not observe that might be correlated with entry into the competition. For example, 17% of our sample participated in the M$V compared to the national estimate of 13.7%. The use of weights will ensure the sample is more representative with respect to postcode, age, gender, and state, but we recognize that the population might not be representative with respect to other variables we do not observe in the data or which are not measured for the population.

The role of financial incentives to increase vaccination rates remains unclear.[3] [18] [20] [21] Their use as nudges to speed up vaccination is likely to be effective. Policies to increase vaccination rate depend on the context and the stage of the pandemic and may interact with other strategies to increase vaccination rates, particularly in vaccine-hesitant populations where other factors are likely to matter more than financial incentives.

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Authors contributions
AS conceived of the study, secured funding, designed the survey questions, contributed to the analysis, wrote and revised the manuscript, and interpreted the results. DJ prepared the data and conducted all statistical analyses, contributed to writing and revising the manuscript, and interpreted results.

Conflict of Interests
None declared.

Data sharing statement
Statistical code for the analysis s available from the Dryad repository, DOI: https://doi.org/10.5061/dryad.rv15dv495. TTPN Survey is a proprietary data set and researchers interested in replication need to seek access to the TTPN survey by contacting the Melbourne Institute.

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Appendix

Appendix Table 1. Number of respondents in each of the categories of vaccination behaviour

	Entrants	Percent	Non-entrants	Percent	Total	Percent
Received first dose before but no second dose	6	1.38%	37	1.92%	43	1.82%
Received first dose before and second dose after	122	28.0%	285	14.80%	407	17.2%
Received first and second dose before	258	59.2%	646	33.54%	904	38.3%
Total who received first dose before	386	88.5%	968	50.26%	1354	57.3%
Received first dose after but not second dose	20	4.59%	82	4.26%	102	4.32%
Received first dose after and second dose after	30	6.88%	88	4.57%	118	5.00%
Total who received first dose after	50	11.5%	170	8.83%	220	9.31%
Total who received second dose after	152	34.9%	373	19.4%	525	22.2%
Total who received first or second dose before (any dose)	386	88.5%	968	50.3%	1354	57.3%
Total who received first or second dose after Sept. 30 (any dose)	172	39.4%	455	23.6%	627	26.5%
Unvaccinated at survey (November)	0	0.0%	788	40.9%	788	33.4%
Total in each group (Entrant vs. Non-entrants)	436	100.0%	1926	100.0%	2362	100.0%
Denominator is rest of sample						
Proportion Anydose after		39.4%		23.6%		26.5%
Proportion first dose after		11.5%		8.83%		9.31%
Proportion second dose after		34.9%		19.4%		22.2%
****the above % correspond to existing Table 1 but are unweighted**						
Proportion Anydose after		96.6%		35.5%		43.0%
Proportion first dose after		28.1%		13.3%		15.1%
Proportion second dose after		85.4%		29.1%		36.0%

Appendix Table 2. Full regression results (n=2,362)

	Any dose after September 30th			First dose after September 30th			Second dose after September 30th		
	Odds ratio	95% CI		Odds ratio	95% CI		Odds ratio	95% CI	
Competition entrant	2.274***	1.727	2.994	1.341	0.885	2.033	2.389***	1.800	3.169
Male	0.700***	0.55	0.891	0.578***	0.399	0.838	0.794*	0.617	1.021
Age 25 - 34	1.088	0.75	1.578	0.916	0.547	1.535	1.210	0.826	1.774
Age 35 - 44	0.668**	0.448	0.995	0.673	0.388	1.169	0.792	0.522	1.201
Age 45 - 49	0.548**	0.33	0.911	0.383**	0.182	0.804	0.767	0.447	1.314
Age 50 - 54	0.309***	0.18	0.528	0.191***	0.066	0.554	0.425***	0.244	0.740
Age 55 - 64	0.332***	0.212	0.519	0.270***	0.138	0.529	0.454***	0.287	0.716
Age 65 - 74	0.405***	0.231	0.711	0.137***	0.054	0.349	0.542**	0.300	0.977
Age 75 above	0.229***	0.102	0.512	0.108***	0.023	0.515	0.284**	0.118	0.682
Having a child under 18	0.708**	0.54	0.929	0.886	0.593	1.325	0.654***	0.494	0.868
HS graduated	1.104	0.72	1.694	1.296	0.692	2.425	0.953	0.603	1.506
Some college	0.961	0.655	1.41	1.059	0.604	1.857	0.932	0.624	1.391
University and above	0.957	0.632	1.45	0.908	0.483	1.706	0.926	0.599	1.432
Income: 25 - 50 percentile	1.122	0.762	1.65	1.201	0.689	2.091	1.135	0.750	1.718
Income: 50 - 75 percentile	1.041	0.693	1.563	1.043	0.566	1.921	1.169	0.758	1.801
Income: 75 percentiles and above	1.009	0.633	1.607	1.289	0.647	2.569	1.032	0.631	1.688
Income: refused	1.141	0.607	2.146	1.758	0.771	4.005	0.903	0.455	1.792
Industry: agriculture, forestry and fishing	2.465*	0.995	6.108	2.843	0.834	9.693	1.353	0.507	3.606
Industry: mining	3.445*	0.942	12.594	6.204***	1.777	21.652	0.442	0.076	2.570
Industry: manufacturing	0.946	0.418	2.138	1.133	0.363	3.539	0.803	0.352	1.832
Industry: electricity, gas, water and waste service	0.618	0.176	2.175	1.165	0.246	5.513	0.559	0.145	2.152
Industry: construction and wholesale	1.035	0.605	1.771	0.772	0.321	1.854	1.052	0.601	1.842
Industry: retail trade	1.112	0.719	1.718	0.775	0.389	1.544	1.004	0.641	1.572
Industry: accommodation and food services	0.369**	0.161	0.85	0.472	0.166	1.341	0.485*	0.209	1.129
Industry: transport, postal and warehousing	1.681	0.822	3.436	2.430*	0.923	6.396	1.237	0.611	2.504
Industry: media and telecommunication	1.589	0.784	3.22	0.970	0.365	2.580	1.748	0.850	3.593

Industry: financial and insurance services	1.089	0.576	2.059	0.840	0.261	2.700	0.956	0.487	1.879
Industry: rental, hiring and real estate services	3.026**	1.217	7.523	6.700**	2.037	22.043	1.006	0.323	3.133
Industry: professional, scientific and technical	1.191	0.666	2.129	1.256	0.520	3.031	1.107	0.613	1.999
Industry: administrative and support services	0.859	0.429	1.72	1.209	0.483	3.029	0.948	0.470	1.912
Industry: public administration and safety	0.439*	0.189	1.021	0.322	0.080	1.301	0.526	0.227	1.218
Industry: education and training	1.441	0.833	2.492	0.558	0.225	1.384	1.592	0.909	2.789
Industry: health care and social assistance	0.799	0.473	1.349	0.794	0.364	1.733	0.890	0.506	1.566
Industry: arts and recreation services	1.192	0.393	3.611	1.125	0.261	4.850	0.928	0.312	2.763
Industry: other services	0.547**	0.316	0.947	0.814	0.350	1.892	0.564*	0.318	1.001
Living in rural	1.251*	0.963	1.625	1.296	0.892	1.882	1.207	0.915	1.592
VIC	1.329*	0.99	1.783	2.458***	1.504	4.016	1.076	0.799	1.449
QLD	0.926	0.608	1.409	2.796***	1.535	5.093	0.605**	0.389	0.942
SA	0.905	0.557	1.472	3.307***	1.705	6.416	0.616*	0.368	1.033
WA	1.316	0.814	2.126	3.117***	1.601	6.069	0.847	0.510	1.405
ACT, TAS, NT	0.676	0.364	1.256	2.441*	0.961	6.202	0.543*	0.281	1.051
Fully vaccinated rate by LGA	1	0.988	1.013	1.010	0.995	1.025	0.998	0.985	1.010
With financial stress	0.873	0.675	1.128	0.832	0.563	1.229	0.925	0.708	1.209
Satisfied with policy	0.857	0.644	1.141	1.097	0.703	1.711	0.724**	0.538	0.972
Not satisfied with policy	1.004	0.738	1.364	0.896	0.572	1.402	0.979	0.710	1.350
Voting liberal or national	1.082	0.764	1.533	0.998	0.574	1.735	1.185	0.822	1.709
Voting labour	1.366*	0.987	1.89	1.226	0.754	1.996	1.386*	0.985	1.949
Voting greens or democrats	1.148	0.772	1.705	1.101	0.620	1.955	1.432*	0.952	2.155
wave 45 (15 - 19 Nov, 2021)	1.283**	1.004	1.639	1.884***	1.322	2.686	1.216	0.941	1.572
Constant	0.433	0.261	1.411	0.027***	0.006	0.123	0.449	0.134	1.509

Notes: Results are based on logit regressions and are all weighted. Respondents who serve as a baseline are as follows: in the youngest age group (18 - 24), income below 25 percentile, education below high school, being out of labour force or do not know the industry that they are in, living in NSW, without voting preference, and indifferent policy satisfaction. * = p value<0.10; ** = p value<0.05; *** = p value<0.01.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	1
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	5
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	5
		(*c*) Explain how missing data were addressed	N/A
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	5
		(*e*) Describe any sensitivity analyses	5-6

Continued next page

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	7
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	N/A
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	N/A
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	7-8
		Cross-sectional study—Report numbers of outcome events or summary measures	7-8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-8
		(*b*) Report category boundaries when continuous variables were categorized	7-8
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8
Discussion			
Key results	18	Summarise key results with reference to study objectives	8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	8-9
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8-10
Generalisability	21	Discuss the generalisability (external validity) of the study results	8-11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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An observational study of the association between COVID-19 vaccination rates and entry into the Australian 'Million Dollar Vax' competition

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An observational study of the association between COVID-19 vaccination rates and entry into the Australian 'Million Dollar Vax' competition

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Abstract

Objectives

To examine the association between financial incentives from entry into a vaccine competition with the probability of vaccination for COVID-19.

Design

A cross-sectional study with adjustment for covariates using logistic regression

Setting

October and November 2021, Australia.

Participants

2,375 respondents of the Taking the Pulse of the Nation Survey

Primary and secondary outcome measures

The proportion of respondents who had any vaccination, a first dose only, or second dose after the competition opened.

Results

Those who entered the competition were 2.27 (95% CI 1.73 to 2.99) times more likely to be vaccinated after the competition opened on October 1st than those who did not enter—an increase in the probability of having any dose of 0.16 (95 % CI 0.10 to 0.21) percentage points. This increase was mostly driven by those receiving second doses. Entrants were 2.39 (95% CI 1.80 to 3.17) times more likely to receive their second dose after the competition opened.

Conclusions

Those who entered the Million Dollar Vax competition were more likely to receive a vaccination after the competition opened compared to those who did not enter the competition, with this effect dominated by those receiving second doses.

Strengths and limitations of this study

- We use a nationally representative sample of individual self-reported vaccination status and timings.
- We distinguish between the association between competition entry and first and second doses.
- We adjust for a rich set of individual characteristics associated with vaccination status, and examine the factors influencing competition entry
- The strong association for second dose vaccinations may reflect some individuals who had already scheduled their second dose after the competition opened, potentially leading to an overestimate of the association.

Background

The effectiveness of using financial incentives to increase vaccination rates for the SARS-COV-2 virus is uncertain.[1],[2],[3] One form of financial incentive has been the entry into vaccination competitions where participants are eligible for large randomly-drawn cash prizes. These have also been referred to as lotteries but unlike lotteries, they do not require cash payment on entry and are not a form of profit-driven gambling. Financial incentives have been used before to encourage childhood immunisation, but not in the form of competitions with cash prizes. Such competitions were established in 2021 to increase vaccination rates for COVID-19, mostly in the United States. For example, the competition in Ohio was run from May to June 2021 with 5 x $1 million prizes over five weeks.

However, the evidence on the effect of such competitions on vaccination rates has been mixed. Four studies using state-level data on vaccination rates over time, and comparing states with vaccination competitions with those with none, found they were ineffective in increasing vaccination rates.[4],[5],[6],[7] Four studies found an increase in vaccination rates[8], [9], [10], [11], including one that found increases in vaccination rates in low-income counties in Ohio but not in high-income counties.[9] One study examined the use of financial incentives across 24 states across the U.S., mainly including vaccination competitions, and found no overall impact on vaccination rates.[12] The reason for these mixed results is unclear as all used aggregate state-level data on changes in vaccination rates over time through each used slightly different methodologies.

Unlike most of this previous work, the aim of this research is to conduct a more granular analysis using individual-level data to examine the association between an individual's decision to get vaccinated and financial incentives. The Million Dollar Vaccination Campaign (M$V) was open to entries from 1st to 31st of October 2021 for those aged 18 years or over who were Australian residents. This was accompanied by a significant national marketing campaign that specifically targeted local areas with low vaccination rates and with populations finding it difficult to access vaccinations. If an entrant was chosen to receive a prize, they were required to show proof of two-dose vaccination in the form of a government-approved electronic vaccination certificate.

M$V was funded by an alliance of philanthropic organisations coordinated by the Summer Foundation. The competition was designed to increase the rate of full (two-dose) vaccinations in the context of meeting national vaccination targets that would trigger the end of harsh lockdowns in the two most populous states, New South Wales and Victoria. The objective was to speed up the rate of vaccination amongst those who intended to get

vaccinated but had not yet done so. This was intended to reduce hospitalisations and ongoing economic costs of lockdowns. Australia's vaccination program started in March 2021. The Therapeutic Goods Administrative approved three vaccines for Australians' use in 2021: Pfizer, AstraZeneca, and Moderna, each requiring two doses for 'full vaccination'. On the 30th of September, just before the competition opened, vaccination rates had steadily increased to 77.8% percent of the population over 16 years old with a first dose and 54.2% with a second dose. New South Wales (NSW) and Victoria, the two most populous states, had experienced outbreaks since July 2021 and were under various forms of lockdown at the end of September, including night-time curfews in Victoria, closure of retail businesses and hospitality, and continuing bans on travel. Lockdowns in NSW were more targeted at specific Local Government Areas (LGAs) with high case numbers. All eight states and territories agreed to a national roadmap on 6th August 2021, with states individually releasing precise targets of population vaccination rates that were linked to the lifting of restrictions throughout the last quarter of 2021, with some target dates at the time the competition was open. For example, in Victoria, the targets were 70% of the population aged 16 and over, (reached on 21st October), 80% (reached on 29th October), and 90% of 12+ years (reached on 18th November) with a second dose. These targets provided non-financial incentives to get a second dose (referred to as fully vaccinated at the time) as restrictions were eased when targets were met, with restrictions largely non-existent after the 90% target was reached.

The competition provided the potential to receive financial incentives to encourage receipt of the first dose for those not vaccinated and provided incentives to those with a first dose to schedule a second dose if they had not already done so. The interval between the first and second doses at the time depended on the vaccine: 4-8 weeks for Astra Zeneca during an outbreak (up to 12 weeks with no outbreak) and 3-6 weeks for Pfizer from July 2021.[13] Those with a first dose may already have had their second dose scheduled during October given the recommended fixed interval between doses, and so the incentives would not influence this group unless they changed their scheduled appointment to receive their second dose earlier or were persuaded not to delay their appointment. Those who already had their second dose before the competition opened could still enter, but their vaccination status would not be affected by the competition.

Method

Patient and public involvement statement. There was no patient or public involvement in the research.

Data and participants. The Taking the Pulse of the Nation (TTPN) Survey was run by the Melbourne Institute and was administered every week from April 2020 and every two weeks from January 2021. Each wave included 1,200 different respondents and so is a repeated cross-section design. The analysis used data from 2,400 respondents in Waves 44 and 45 conducted in November 2021 after the competition was closed at the end of October. Of 2,400 respondents, 2,375 responded to the vaccination question. A further 13 respondents did not know the month they received their first vaccination, leaving 2,362 for our analysis as a final sample.

The TTPN Survey dataset was collected by a commercial provider using a mixed-mode procedure. TTPN was designed to track changes in the economic and social well-being of Australians during the pandemic. For each wave, 400 respondents were interviewed by telephone, and 800 respondents completed a web survey. The survey provider constructed the sampling frame from a diverse set of continuously updated proprietary databases. The survey sampling procedure followed strict quotas for six states and the Australian Capital Territory (ACT). Each wave included 600 men and 600 women, and the shares of respondents for each state and ACT are proportional to the population of that state or territory. Data collection for each survey wave took up to six days to collect until the gender/state quotas are reached. These data have been extensively used in previous research about COVID-19 including Australian's hesitancy to get vaccinated, vaccine choice, border re-opening decisions, and responses towards workplace vaccination and testing mandate.[14], [15], [16], [17]

The raw share of each state/location/gender/age-group strata in the survey sample was not necessarily the same as the share of this stratum in the population. For each survey wave, post-stratification inverse probability weights were calculated based on Greater Capital City Statistical Area (GCCSA) or 'Rest of State' for each state using respondents' postcode, age group (18-24, 24-35, 35-44, 45-54, 55-64, 64-75), and gender. The populations of each stratum are calculated based on the latest ABS estimated resident population projections from the 2016 Census. These weights were used in all analyses.

Study design and hypothesis. Using data from a cross-sectional survey, the main hypothesis is whether the proportion of all respondents who were vaccinated after September 30th is different for those who entered the competition compared to those who did not. Unlike some U.S. lotteries where the whole population was automatically entered, each person entered the M$V voluntarily by completing a short webform providing their contact details. Proof of vaccination was not required at entry though individuals had to tick a box on the webpage

stating that they had at least their first dose. Those who had already had their second dose before the competition opened could enter. If they were chosen to receive a prize (a provisional winner), they were required to show proof of full vaccination (interpreted at the time as two doses) in the form of a government-approved electronic vaccination certificate. To claim a prize full (two-dose) vaccination must have occurred before 13th December, or no later than 13th January, depending on the required interval between first and second doses, which may vary across States and be up to 12 weeks. Only one entry per person was allowed.

The competition had a $AU 1 million ($US 0.72 million) Grand Prize in cash and a total of 3,100 daily prizes of $AU 1,000, with a total prize pool of $AU 4.1 million. Each entrant was eligible for the Grand Prize draw and the daily draw on the entry date. The daily prizes were in the form of a gift card that could be used at a range of participating stores. The lottery was accompanied by a $AU 3 million marketing campaign led by Sayers that included peak-time TV, radio, and full-page national and regional newspaper advertising, extensive social media advertising, and outdoor media. The campaign targeted culturally and linguistically diverse audiences and included advertising in languages such as Mandarin, Arabic, and Vietnamese, and areas with high populations of Indigenous people. As the campaign progressed, the targeting became more granular and nuanced in response to the analysis of data regarding the reach of the campaign, competition entrants, and vaccination rates in specific geographic locations throughout Australia. In response to concerns raised on social media about M$V being a scam, the campaign pivoted to engage and profile daily draw winners and to provide social proof about the legitimacy of M$V. When the competition closed, 2,744,974 Australians had entered, representing 13.7% of the adult population. The study design exploited information on the month individuals received their first or second dose of a COVID vaccine which was asked in Waves 44 and 45 after the competition had closed.

Variables. Participants were asked the following questions during Waves 44 and 45 in November 2021 to determine their vaccination status. *"Are you willing to have the COVID-19 vaccine? (1) Yes, (2) No, (3) Don't Know (4), I have had the first dose of the vaccine only (5), I have had the first and second dose of the vaccine*." If they answered option (4) they were asked the month of their first vaccination. If they answered option (5), they were asked the month of their first and second vaccination. They were separately asked, *"Did you enter the Million Dollar Vax Lottery? (1) Yes, 2) No.*" which is used to define the main independent variable of competition entry.

The main outcome variable is defined according to the timing of each individual's vaccination and is equal to one for those who reported receiving any vaccination after the competition opened in October and is zero for the rest of the respondents. The denominator includes respondents who were either unvaccinated or those who received their first or second dose before October. The unvaccinated are in the denominator only for the group who did not enter the competition as this group could potentially have changed their decision in response to the competition – that is they were 'eligible' to be vaccinated. In addition, we separately analysed those who had only their first dose after the competition opened and those who had their second dose after the competition opened.

TTPN asked a range of questions known to be associated with vaccination status, so these were included as independent variables in the analysis. We included indicators for male, age categories (aged 25-34; aged 35-44; aged 45-49; aged 50-54; aged55-64; aged 65-74; 75+), having a child under 18, income categories (25-50 percentile; 50-75 percentile; 75 percentile+; refused to report), education categories (high school graduates; some college; university and above), and categories of the industry relative to the unemployed (agriculture; mining; manufacturing; electricity; construction; wholesale; retail; food services; transport; information media; insurance services; real estate services; professional, scientific and technical services; administrative services; public administration; education; healthcare assistance; arts and recreation services; other). These categories are defined using 2006 Australian and New Zealand Standard Industry Classification from the Australian Bureau of Statistics. Indicators for the states of residence and living in a rural area were included. Indicators for financial stress, policy satisfaction (satisfied; not satisfied), voting preferences (liberal or national; labour; greens or democrats) were included, and an indicator for wave 45 (15 - 19, November) was included.

The vaccination rates of individuals could be associated with the vaccination rates of others in their LGA through neighbourhood peer effects, the location of vaccination providers, and other LGA-specific factors. In addition, M$V targeted LGAs with low vaccination rates, and so LGA vaccination rates would be associated with the competition entry. We, therefore, merged data on LGA-level vaccination rates using each respondent's postcode of residence.

Statistical analysis. Data were analysed using logistic regression with aforementioned covariates as independent variables to adjust for observed differences between those participating in the competition and those who did not. We chose a logistic model to estimate

the probability of receiving a vaccine if the respondent entered the competition after September 30th. Separate regressions were conducted for those receiving their first vaccination after September 30th and those receiving their second vaccination after September 30th. Results were reported as odds ratios and differences in predicted probabilities of being vaccinated, with 95% confidence intervals.

Results

Descriptive statistics of our final sample. When the survey was completed in November (after entry had closed), 60.4% of all respondents had received two doses, and 6.1% had only their first. Among those who had not yet received their first dose, 65.7% were willing to be vaccinated, 21.8% were unwilling to be vaccinated, and 12.4% were unsure.

Table 1 shows the weighted descriptive statistics of the sample used in the analysis and compares those who participated in the competition with those who did not. Seventeen percent of respondents participated in the competition. After the competition opened on October 1st, 25.2% of respondents received a vaccination. Of those who entered the lottery, 39.3% received a vaccination after the competition opened on October 1st, compared to 22.4% of those who did not enter. After the competition opened, 8.8% of respondents received their first dose. The percentage of those who entered the competition and who received their first dose after it opened was 11.5%, compared to 8.2% for those who did not enter. The proportion who received their second dose after the competition opened was higher at 20.9%. Of those who entered the competition, 34.3% received their second dose after the competition opened compared to 18.2% of respondents who did not enter. Appendix Table A1 shows the unweighted number of respondents in each of the categories of vaccination timing and competition entry which were used to construct the dependent variables in the last three rows of this table.

Those who chose to enter the competition were more likely to be female, more likely to be between 50 and 64 years old, and less likely to be over 65. Those who entered were likely to have a higher income. There was also a higher proportion of entrants in Victoria.

Table 1: Descriptive Statistics

	Full Sample		Entrant		Non-entrant	
	Mean	Std.	Mean	Std.	Mean	Std
Proportion receiving any dose after September 30th	0.252	0.434	0.393	0.489	0.224	0.417
Proportion receiving first dose after September 30th	0.088	0.283	0.115	0.320	0.082	0.275
Proportion receiving second dose after September 30th	0.209	0.407	0.343	0.475	0.182	0.386

Competition entrant	0.169	0.375	1.000	0.000	0.000	0.000
Male	0.485	0.500	0.412	0.493	0.500	0.500
Age 18 - 24	0.116	0.321	0.099	0.299	0.120	0.325
Age 25 - 34	0.192	0.394	0.182	0.386	0.194	0.396
Age 35 - 44	0.173	0.378	0.189	0.392	0.169	0.375
Age 45 - 49	0.084	0.277	0.104	0.305	0.080	0.271
Age 50 - 54	0.081	0.273	0.129	0.335	0.071	0.257
Age 55 - 64	0.153	0.360	0.194	0.396	0.144	0.351
Age 65 - 74	0.120	0.325	0.086	0.281	0.126	0.332
Age 75 and above	0.082	0.274	0.017	0.131	0.095	0.293
Having a child below 18	0.311	0.463	0.321	0.467	0.309	0.462
Not graduated high school/NA	0.161	0.368	0.140	0.347	0.166	0.372
High school graduated	0.173	0.378	0.147	0.355	0.178	0.383
Some college	0.308	0.462	0.327	0.470	0.304	0.460
University and above	0.357	0.479	0.386	0.487	0.352	0.478
Income: below 25 percentile	0.188	0.391	0.132	0.339	0.199	0.399
Income: 25 - 50 percentile	0.288	0.453	0.281	0.450	0.290	0.454
Income: 50 - 75 percentile	0.251	0.434	0.250	0.434	0.251	0.434
Income: 75 and above percentile	0.199	0.400	0.235	0.425	0.192	0.394
Income: refused	0.074	0.262	0.101	0.302	0.068	0.253
Industry: agriculture, forestry and fishing	0.014	0.119	0.011	0.105	0.015	0.122
Industry: mining	0.008	0.089	0.011	0.105	0.007	0.085
Industry: manufacturing	0.026	0.159	0.021	0.144	0.027	0.162
Industry: electricity, gas, water service	0.013	0.114	0.003	0.052	0.015	0.123
Industry: construction and wholesale	0.043	0.202	0.051	0.220	0.041	0.198
Industry: retail trade	0.072	0.258	0.093	0.291	0.067	0.250
Industry: accommodation and food	0.021	0.143	0.014	0.119	0.022	0.148
Industry: transport and warehousing	0.029	0.167	0.009	0.096	0.032	0.177
Industry: media and telecommunication	0.026	0.158	0.026	0.159	0.026	0.158
Industry: financial and insurance services	0.044	0.205	0.028	0.164	0.047	0.212
Industry: rental, hiring and real estate	0.009	0.093	0.007	0.080	0.009	0.095
Industry: professional and scientific	0.043	0.203	0.045	0.208	0.043	0.202
Industry: administrative and support	0.019	0.138	0.021	0.142	0.019	0.137
Industry: public administration and safety	0.022	0.146	0.033	0.178	0.020	0.138
Industry: education and training	0.039	0.194	0.053	0.224	0.036	0.187
Industry: health care and social assistance	0.061	0.239	0.079	0.271	0.057	0.232
Industry: arts and recreation services	0.011	0.105	0.016	0.127	0.010	0.100
Industry: other services	0.059	0.235	0.054	0.226	0.060	0.237
Industry: refused/don't know/not in the labor force	0.442	0.497	0.424	0.495	0.446	0.497
Living in rural	0.316	0.465	0.306	0.461	0.318	0.466
NSW	0.329	0.470	0.271	0.445	0.341	0.474
VIC	0.263	0.441	0.324	0.468	0.251	0.434
QLD	0.204	0.403	0.196	0.397	0.205	0.404
SA	0.070	0.255	0.057	0.232	0.073	0.260
WA	0.102	0.303	0.127	0.334	0.097	0.296
ACT, TAS, NT	0.031	0.174	0.025	0.157	0.033	0.178
Fully Vaccinated rate by LGA	78.420	14.000	79.794	11.624	78.166	14.424
With Financial Stress	0.436	0.496	0.447	0.498	0.434	0.496
Satisfied with policy	0.428	0.495	0.435	0.496	0.427	0.495
Not satisfied with policy	0.252	0.434	0.211	0.409	0.260	0.439
Indifferent with policy	0.320	0.467	0.354	0.479	0.313	0.464
Voting liberal or national	0.342	0.475	0.329	0.470	0.345	0.476
Voting labour	0.324	0.468	0.350	0.478	0.319	0.466
Voting greens or democrats	0.114	0.318	0.086	0.281	0.120	0.325
Voting others/no preference	0.219	0.414	0.235	0.424	0.216	0.412
Wave 44 (1 - 6, Nov 2021)	0.500	0.500	0.465	0.499	0.507	0.500
Wave 45 (15 – 19, Nov 2021)	0.500	0.500	0.535	0.499	0.493	0.500
Number of observations	2,362		436		1,926	

Note: Data are weighted

Regression results for the association of competition entry and vaccination take-up

Table 2 presents the results from the unadjusted logistic regressions that include only the dummy variable (entrants vs non-entrants) as an independent variable, and from the adjusted logistic regressions that include all covariates in Table 1 as independent variables. The differences between the adjusted and unadjusted models are small. Competition entry is associated with a higher proportion of respondents having any dose after September 30th. Those who entered were 2.27 times more likely to have a vaccination after September 30th compared to everyone else. This is equivalent to an increase in the probability of having any dose of 0.155 (95% CI 0.100 to 0.210) compared to everyone else. Entry was associated with a 0.022 (95% CI -0.011 to 0.056) increase in the probability of getting the first dose after September 30th, but this was not statistically significant in the adjusted analysis, with the association driven by people getting their second dose. Those who entered were 2.39 times more likely to have a second dose after September 30th compared to everyone else. This is equivalent to an increase in the probability of a second dose after September 30th of 0.152 (95% CI 0.098 to 0.206) compared to everyone else.

Table 2: Adjusted and Unadjusted Regressions

	Any dose after September 30th	First dose after September 30th	Second dose after September 30th
Adjusted analysis			
Entrant vs. non-entrant (Odds Ratio, 95% CI)	2.274*** (1.727 to 2.994)	1.341 (0.884 to 2.033)	2.389*** (1.800 to 3.169)
Change in probability (95% CI)	0.155*** (0.100 to 0.210)	0.022 (-0.011 to 0.056)	0.152*** (0.098 to 0.206)
Unadjusted analysis			
Entrant vs. non-entrant (Odds Ratio, 95% CI)	2.249*** (1.732 to 2.919)	1.451* (0.971 to 2.169)	2.351*** (1.795 to 3.080)
Change in probability (95% CI)	0.169*** (0.111 to 0.228)	0.033 (-0.006 to 0.072)	0.161 (0.105 to 0.217)
Number of observations	2,362	2,362	2,362

Notes: Results are based on logistic regressions and are all weighted. Respondents who serve as a baseline for categorical variables are in the youngest age group (18 - 24), income is below 25 percentile, education below high school, being unemployed or do not know the industry that they are in, living in NSW, without voting preference, and indifferent policy satisfaction. Full results are available in Appendix Table 2. * = p value<0.10; ** = p value<0.05; *** = p value<0.01.

Appendix Table A2 shows that males, those in older age groups, those with children under 18, those working in accommodation and food services, public admin and safety, and other services were less likely to receive any vaccine after September 30th: that is they were more likely to have been vaccinated earlier. There is a strong age gradient suggesting that older people were more likely to get vaccinated before October 1st reflecting that these age

groups were eligible to be vaccinated earlier than the younger age groups. Those in rental, hiring, and real estate services were more likely to get vaccinated after September 30th compared to those who were out of the labour force.

Characteristics for those who enter the competition Of those who entered the competition, 60.6% had been vaccinated (either first or second dose) before the competition opened, compared to 35.5% of non-entrants. Table 3 examines the characetristics of those who are more likely to enter the competition. Males were less likely to do so compared to females. Relative to those aged 18-24, respondents aged 50-54 were more likely to enter, while those older than 65 were less likely to enter. Compared to those in the lowest income quartile, people in the highest income quartile were more likely to enter. Those working in manufacturing, electricity, gas, water services, accommodation and food services, transport, postal and warehousing, and financial and insurance services were less likely to enter than those who were unemployed. Respondents in LGAs with higher vaccination rates were more likely to enter. Compared to those living in NSW, respondents living in Victoria, Queensland, and Western Australia were more likely to enter M$V.

Table 3: Association with entry into M$V (n=2,362)

	Odds ratio	95% CI	
Male	0.756**	0.574	0.994
Age 25 – 34	1.007	0.624	1.624
Age 35 – 44	1.230	0.750	2.019
Age 45 – 49	1.294	0.736	2.274
Age 50 – 54	1.860**	1.070	3.235
Age 55 – 64	1.316	0.799	2.167
Age 65 – 74	0.534*	0.285	1.003
Age 75 above	0.145***	0.055	0.381
Having a child under 18	0.891	0.652	1.216
High school graduated	0.816	0.509	1.309
Some college	1.078	0.705	1.648
University and above	1.280	0.821	1.994
Income: 25 - 50 percentile	1.339	0.871	2.060
Income: 50 - 75 percentile	1.317	0.827	2.097
Income: 75 percentile and above	1.531	0.913	2.568
Income: refused	1.987**	1.123	3.515
Industry: agriculture, forestry and fishing	0.647	0.237	1.765
Industry: mining	0.917	0.184	4.581
Industry: manufacturing	0.529	0.227	1.233
Industry: electricity, gas, water and waste services	0.151*	0.020	1.153
Industry: construction and wholesale	0.885	0.465	1.685
Industry: retail trade	1.085	0.674	1.746
Industry: accommodation and food services	0.448*	0.187	1.076
Industry: transport, postal and warehousing	0.212***	0.066	0.682
Industry: media and telecommunication	0.699	0.319	1.531
Industry: financial and insurance services	0.430	0.185	1.002
Industry: rental, hiring, and real estate services	0.487	0.098	2.417

Industry: professional, scientific and technical	0.700	0.356	1.376
Industry: administrative and support services	0.742	0.331	1.667
Industry: public administration and safety	0.997	0.460	2.161
Industry: education and training	0.839	0.434	1.623
Industry: health care and social assistance	0.830	0.495	1.391
Industry: arts and recreation services	1.390	0.469	4.121
Industry: other services	0.625*	0.357	1.094
Living in rural	1.095	0.830	1.445
VIC	1.703***	1.208	2.401
QLD	1.668**	1.038	2.680
SA	1.363	0.797	2.330
WA	2.170***	1.277	3.685
ACT, TAS, NT	1.192	0.620	2.293
Fully vaccinated rate by LGA	1.017***	1.004	1.030
With financial stress	1.101	0.836	1.450
Satisfied with policy	0.973	0.715	1.326
Not satisfied with policy	0.744*	0.528	1.049
Voting liberal or national	1.032	0.719	1.482
Voting labour	1.112	0.790	1.564
Voting greens or democrats	0.712	0.441	1.149
Wave 45 (15 - 19 Nov, 2021)	1.055	0.812	1.371
Constant	0.034***	0.010	0.116

Notes: Results are based on logistic regressions and the estimates are all weighted. Respondents who serve as a baseline for categorical variables are in the youngest age group (18-24), income is below 25 percentile, education below high school, being unemployed or do not know the industry that they are in, living in NSW, without voting preference, and indifferent policy satisfaction. * = p value<0.10; ** = p value<0.05; *** = p value<0.01.

Discussion

This study finds evidence of a statistically significant association between entry into the M$V competition and receipt of vaccination after the competition opened on October 1st. The association was driven by those who had received a second dose after September 30th. Those who received their second dose after the competition opened included those who had previously received the first dose sometime before October 1st and decided to schedule their second dose in response to the financial incentives. Some in this group could have brought their appointment forward or were persuaded not to delay their appointment any further. However, others in this group would not have been influenced by financial incentives if their second appointment had already been booked. This could lead to an overestimate of the effect of competition entry participation on vaccination rates.

Distinguishing between the effect of financial incentives on first and second doses is important for policy as they imply different objectives and the targeting of policy towards different groups of the population. M$V aimed to encourage the population to achieve second-dose vaccination targets more quickly than would otherwise have happened. M$V was therefore focused on individuals who are already motivated. It is not surprising that the competition was not associated with an increase in first doses given the more complex range of factors influencing vaccine hesitancy.

Our research adds to the literature using a unique and representative sample of individuals from Australia when the M$V competition was open. Previous evidence from the U.S., including several evaluations of the Ohio vaccine incentives, shows mixed results using difference-in-difference study designs. Of five studies that examined first doses[4] [7] [8] [9] [11], three found evidence of an effect of incentives. [8] [9] [11] Of two studies that examined second doses [4] [5], only one found an effect.[5] Two studies[6] [10] used the total rate of vaccinations combining first and second doses and one of these found an effect[10].

The Ohio incentives and M$V were designed differently, implemented at different times during the pandemic, and may have had different marketing campaigns and this may influence the results. The whole population of Ohio was eligible to win whereas the M$V competition required individuals to enter. In the U.S. at that time the rate of vaccination was slowing, suggesting a lack of motivation in the population. In addition, October 2021 was a time when vaccination rates were steadily increasing and when vaccination targets focussing on second doses had been set by some states that were linked to the lifting of harsh lockdowns. Generally, the Australian population was more motivated to get vaccinated and the M$V competition added to this motivation. People who were already fully vaccinated may have interpreted the competition as a reward for their patience during lockdowns and for their earlier decision to get vaccinated, and for this group therefore the competition did not influence their decision to get vaccinated.

Our results found that those with higher incomes were more likely to participate in the M$V competition. Though the literature on cash lotteries suggests those on lower incomes are more likely to enter, recall that vaccination competitions are not lotteries as they do not involve gambling.[18][19] The financial incentives offered through entry into M$V were likely to have been perceived as a reward for getting vaccinated and this perception may have been more widely held by those with higher incomes. The results also showed that those in LGAs with higher vaccination rates were more likely to enter the competition compared to LGAs with lower vaccination rates, suggesting that those who might have already been vaccinated before October 1st were more likely to enter. The M$V marketing campaign targeted LGAs with lower vaccination rates and so assumed the campaign would be more effective in these LGAs. Our results suggest that targeted marketing to persuade people to enter a vaccine competition could be less effective in more vaccine-hesitant populations where vaccination decisions are determined by a more complex range of factors that influence access, information, and beliefs.[20] In line with the objectives of M$V, vaccine competitions are more effective as ‘nudges’ for people to get their second dose more quickly.

We do not examine the overall vaccination rate but the timing of when people received their second vaccination, so our numerical results are not comparable to those from other studies that use changes over time in population vaccination rates or the number of vaccines administered. Our data are self-reported and there is a risk of over-reporting of vaccination rates due to social desirability bias. However, this is unlikely as our self-reported rate of second vaccinations of 59.9% in the sample is lower than official data at the time it was collected (77.5% on November 1st and 87% on November 30th). This also raises concerns about the representativeness of our sample. Though our sample is representative of states and territories and uses weights based on location, gender, and age, it is from a commercial panel where respondents might be different from the general population who do not participate in commercial panel surveys in ways we do not observe that might be correlated with entry into competitions. For example, 17% of our sample participated in the M$V compared to the national estimate of 13.7%. The use of weights will ensure the sample is more representative with respect to postcode, age, gender, and state, but we recognize that the population might not be representative with respect to other variables we do not observe in the data or which are not measured for the population.

Our results are also driven by the inclusion of the unvaccinated in the denominator of the control group (non-entrants). By design, there are no unvaccinated respondents amongst lottery entrants. It is appropriate to include the unvaccinated as we report population estimates of vaccination. If we exclude the unvaccinated then this increases the probability of receiving any vaccination amongst non-entrants from 23.6 percent to 40 percent (unweighted data from Appendix Table A1) and so the difference in the percentage vaccinated compared to competition entrants falls to be close to zero. However, the inclusion of unvaccinated respondents is necessary to reflect a population estimate of the association since the unvaccinated were eligible to be vaccinated and chose not to do so, even after the competition opened.

The role of financial incentives to increase vaccination rates remains unclear.[3] [18] [20] [21] Their use as nudges to speed up vaccination is likely to be effective. Policies to increase vaccination rates depend on the context and the stage of the pandemic and may interact with other strategies to increase vaccination rates, particularly in vaccine-hesitant populations where other factors are likely to matter more than financial incentives.

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Authors contributions
AS conceived of the study, secured funding, designed the survey questions, contributed to the analysis, wrote and revised the manuscript, and interpreted the results. DJ prepared the data and conducted all statistical analyses, contributed to writing and revising the manuscript, and interpreted results.

Conflict of Interests
None declared.

Data sharing statement
Statistical code for the analysis s available from the Dryad repository, DOI: https://doi.org/10.5061/dryad.rv15dv495. TTPN Survey is a proprietary data set and researchers interested in replication need to seek access to the TTPN survey by contacting the Melbourne Institute.

Ethics statement
This study was approved by the University of Melbourne Faculty of Business and Economics & Melbourne Business School Human Ethics Advisory Group (Ref: 2056754.1).

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Appendix

Table A1. Number of respondents in each of the categories of vaccination timing

	Entrants	Percent	Non-entrants	Percent	Total	Percent
1. Received first dose before but no second dose	6	1.38%	37	1.92%	43	1.82%
2. Received first dose before and second dose after	122	28.0%	285	14.80%	407	17.2%
3. Received first and second dose before	258	59.2%	646	33.54%	904	38.3%
4. Received first dose after but not second dose	20	4.59%	82	4.26%	102	4.32%
5. Received first dose after and second dose after	30	6.88%	88	4.57%	118	5.00%
6. Unvaccinated at survey (November)	0	0.0%	788	40.9%	788	33.4%
Received any dose after October (2+4+5)	172	39.4%	455	23.6%	627	26.5%
Received first dose after October (4+5)	50	11.5%	170	8.8%	220	9.3%
Received second dose after October (2+5)	152	34.9%	373	19.4%	525	22.2%
Total	436	100.0%	1926	100.0%	2362	100.0%

Table A2. Full regression results (n=2,362)

	Any dose after September 30th			First dose after September 30th			Second dose after September 30th		
	Odds ratio	95% CI		Odds ratio	95% CI		Odds ratio	95% CI	
Competition entrant	2.274***	1.727	2.994	1.341	0.885	2.033	2.389***	1.800	3.169
Male	0.700***	0.55	0.891	0.578***	0.399	0.838	0.794*	0.617	1.021
Age 25 - 34	1.088	0.75	1.578	0.916	0.547	1.535	1.210	0.826	1.774
Age 35 - 44	0.668**	0.448	0.995	0.673	0.388	1.169	0.792	0.522	1.201
Age 45 - 49	0.548**	0.33	0.911	0.383**	0.182	0.804	0.767	0.447	1.314
Age 50 - 54	0.309***	0.18	0.528	0.191***	0.066	0.554	0.425***	0.244	0.740
Age 55 - 64	0.332***	0.212	0.519	0.270***	0.138	0.529	0.454***	0.287	0.716
Age 65 - 74	0.405***	0.231	0.711	0.137***	0.054	0.349	0.542**	0.300	0.977
Age 75 above	0.229***	0.102	0.512	0.108***	0.023	0.515	0.284**	0.118	0.682
Having a child under 18	0.708**	0.54	0.929	0.886	0.593	1.325	0.654***	0.494	0.868
HS graduated	1.104	0.72	1.694	1.296	0.692	2.425	0.953	0.603	1.506
Some college	0.961	0.655	1.41	1.059	0.604	1.857	0.932	0.624	1.391
University and above	0.957	0.632	1.45	0.908	0.483	1.706	0.926	0.599	1.432
Income: 25 - 50 percentile	1.122	0.762	1.65	1.201	0.689	2.091	1.135	0.750	1.718
Income: 50 - 75 percentile	1.041	0.693	1.563	1.043	0.566	1.921	1.169	0.758	1.801
Income: 75 percentiles and above	1.009	0.633	1.607	1.289	0.647	2.569	1.032	0.631	1.688
Income: refused	1.141	0.607	2.146	1.758	0.771	4.005	0.903	0.455	1.792
Industry: agriculture, forestry and fishing	2.465*	0.995	6.108	2.843	0.834	9.693	1.353	0.507	3.606
Industry: mining	3.445*	0.942	12.594	6.204***	1.777	21.652	0.442	0.076	2.570
Industry: manufacturing	0.946	0.418	2.138	1.133	0.363	3.539	0.803	0.352	1.832
Industry: electricity, gas, water and waste service	0.618	0.176	2.175	1.165	0.246	5.513	0.559	0.145	2.152
Industry: construction and wholesale	1.035	0.605	1.771	0.772	0.321	1.854	1.052	0.601	1.842
Industry: retail trade	1.112	0.719	1.718	0.775	0.389	1.544	1.004	0.641	1.572
Industry: accommodation and food services	0.369**	0.161	0.85	0.472	0.166	1.341	0.485*	0.209	1.129
Industry: transport, postal and warehousing	1.681	0.822	3.436	2.430*	0.923	6.396	1.237	0.611	2.504
Industry: media and telecommunication	1.589	0.784	3.22	0.970	0.365	2.580	1.748	0.850	3.593
Industry: financial and insurance services	1.089	0.576	2.059	0.840	0.261	2.700	0.956	0.487	1.879
Industry: rental, hiring and real estate services	3.026**	1.217	7.523	6.700**	2.037	22.043	1.006	0.323	3.133
Industry: professional, scientific and technical	1.191	0.666	2.129	1.256	0.520	3.031	1.107	0.613	1.999
Industry: administrative and support services	0.859	0.429	1.72	1.209	0.483	3.029	0.948	0.470	1.912
Industry: public administration and safety	0.439*	0.189	1.021	0.322	0.080	1.301	0.526	0.227	1.218
Industry: education and training	1.441	0.833	2.492	0.558	0.225	1.384	1.592	0.909	2.789
Industry: health care and social assistance	0.799	0.473	1.349	0.794	0.364	1.733	0.890	0.506	1.566
Industry: arts and recreation services	1.192	0.393	3.611	1.125	0.261	4.850	0.928	0.312	2.763
Industry: other services	0.547**	0.316	0.947	0.814	0.350	1.892	0.564*	0.318	1.001
Living in rural	1.251*	0.963	1.625	1.296	0.892	1.882	1.207	0.915	1.592
VIC	1.329*	0.99	1.783	2.458***	1.504	4.016	1.076	0.799	1.449
QLD	0.926	0.608	1.409	2.796***	1.535	5.093	0.605**	0.389	0.942
SA	0.905	0.557	1.472	3.307***	1.705	6.416	0.616*	0.368	1.033
WA	1.316	0.814	2.126	3.117***	1.601	6.069	0.847	0.510	1.405
ACT, TAS, NT	0.676	0.364	1.256	2.441*	0.961	6.202	0.543*	0.281	1.051
Fully vaccinated rate by LGA	1	0.988	1.013	1.010	0.995	1.025	0.998	0.985	1.010
With financial stress	0.873	0.675	1.128	0.832	0.563	1.229	0.925	0.708	1.209
Satisfied with policy	0.857	0.644	1.141	1.097	0.703	1.711	0.724**	0.538	0.972
Not satisfied with policy	1.004	0.738	1.364	0.896	0.572	1.402	0.979	0.710	1.350
Voting liberal or national	1.082	0.764	1.533	0.998	0.574	1.735	1.185	0.822	1.709
Voting labour	1.366*	0.987	1.89	1.226	0.754	1.996	1.386*	0.985	1.949
Voting greens or democrats	1.148	0.772	1.705	1.101	0.620	1.955	1.432*	0.952	2.155
wave 45 (15 - 19 Nov, 2021)	1.283**	1.004	1.639	1.884***	1.322	2.686	1.216	0.941	1.572
Constant	0.433	0.261	1.411	0.027***	0.006	0.123	0.449	0.134	1.509

Notes: Results are based on logit regressions and are all weighted. Respondents who serve as a baseline are as follows: in the youngest age group (18 - 24), income below 25 percentile, education below high school, being out of labour force or do not know the industry that they are in, living in NSW, without voting preference, and indifferent policy satisfaction. * = p value<0.10; ** = p value<0.05; *** = p value<0.01.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	1
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	5
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	5
		(*c*) Explain how missing data were addressed	N/A
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	5
		(*e*) Describe any sensitivity analyses	5-6

Continued next page

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	7
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	N/A
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	N/A
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	7-8
		Cross-sectional study—Report numbers of outcome events or summary measures	7-8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-8
		(*b*) Report category boundaries when continuous variables were categorized	7-8
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8
Discussion			
Key results	18	Summarise key results with reference to study objectives	8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	8-9
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8-10
Generalisability	21	Discuss the generalisability (external validity) of the study results	8-11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.