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Research Article

A Cross-sectional Study of the Side Effects of BNT162b2 mRNA COVID-19 Vaccine on University Students Aged 18-30 with Detailed Self-reported Symptoms

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Abstract

Background: The Hong Kong Government announced the arrangement of a city-wide COVID-19 Vaccination Program with the provision of BioNTech vaccines in 29 Community Vaccination Centres in December, 2021. According to the List of Serious or Unexpected Adverse Events Following Immunization (AEFI), the cumulative number of report received for Comirnaty COVID-19 mRNA Vaccine (BNT162b2) as at 30th September is 81 cases per 100,000 disease administered which account for 0.08% of total vaccination. Among all age groups, the age group of 20-29 are the least reported age group among citizens which had 55 cases per 100,000 doses administered. It reveals the adverse effects of vaccines are mostly underreported.

Method: The information in this study was gathered by a Qualtrics questionnaire (online survey). The result includes the responses of 425 individuals. Adverse effects of BNT162b2 vaccine after the first and second doses were reported.

Results: The participants reported similar effects on the first and second doses. The most common side effects were generalized symptoms including fatigue and fever, localized symptoms such as injection site reactions, soreness, and myalgia. Other predominant symptoms included: dizziness, chills, headache, nausea, diarrhea, palpitations, joint pain, flushing and sweating. Some respondents also reported symptoms included: insonmia, shortness of breath, chest pain and spasm.

Conclusion: Majority of the adverse effects reported in this study were consistent with existing studies and guidelines overseas. However, further policies and studies are needed to shorten the gap to inform and protect vaccine recipients in the long-run. Furthermore, Correlation between chronic conditions (allergies or eczema) and specific symptoms (myalgia or soreness), and correlation of gender to the perceived impact of symptoms on daily functioning were analyzed. However, various factors can result in this correlation. Hence, further investigations and literature are necessary.

Keywords: COVID-19; SARS-CoV-2; WHO

Introduction

In December 2019, a man in China was found to be infected with a respiratory disease with unknown root and cause. Later in early 2020, this disease was found to be caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which is another strand of SARS-CoV that resulted in 298 deaths in Hong Kong back in 2003. With the first case reported, COVID-19 was soon spread to different countries around the globe, and on 11 March 2020, the World Health Organization (WHO) declared this outbreak as a pandemic [1].

Facing this newly emerged disease with lack of investigation and knowledge, at that time, there was no effective or appropriate treatment or vaccine to protect the public. Until 11 November 2020, German company BioNTech and New York-based Pfizer announced

the successful development of a mRNA-based SARS-CoV-2 vaccine (BNT162b2 mRNA vaccine) that had passed through 3 phases of clinical trials with an efficacy rate of 91% [2]. A systematic review was also conducted by Kai., *et al*. showing it has an efficacy rate of up to 95% [3]. It was the first ever vaccine developed against COVID-19 and also the first ever vaccine formulated using the pioneering mRNA technology that is safe and effective for use [4]. On 31 December 2020, the WHO had listed the BioNTech/Pfizer vaccine for emergency use (EUL) [5].

The outbreak of COVID-19 has brought great influence to Hong Kong. As of September 30, 2021, a total of 12 218 persons had been infected with COVID-19 in Hong Kong, of which 213 died (The Government of the Hong Kong Special Administrative Region, 2021) [6].

On February 18, 2021, the Hong Kong Government announced the arrangement of a city-wide COVID-19 Vaccination Program with the provision of Sinovac and BioNTech vaccines in 29 Community Vaccination Centres (CVCs) [7]. Eligible Hong Kong residents can make an inoculation appointment via the official website.

The vaccination rate especially among the younger generation was unsatisfactory at first. Until May 2021, major universities in Hong Kong started to request all students and staff to complete two doses of vaccine in order to return to the campuses and student halls, otherwise regular antigen testing has to be done before they can enter any school premises [8].

With the aforementioned rules implemented, as at 9 Oct, 2021, 8,801,428 doses of the two vaccines were administered in the city with 5,602,827 doses being BioNTech [9], which accounted for 63.66% of the total number mentioned. Showing most people in the city preferred Comirnaty.

According to the List of Serious or Unexpected Adverse Events Following Immunization (AEFI), the cumulative number of report received for Comirnaty COVID-19 mRNA Vaccine (BNT162b2) as at 30th September is 81 cases per 100,000 disease administered which account for 0.08% of total vaccination (Hong Kong Drug Office, 2021) [10]. The cases of adverse effects are collected via the COVID-19 Vaccine Adverse Event on-line Reporting System by healthcare professionals or the reporting system with Hospital Authority during hospitalization. Through our observation, some citizens did not seek medical advice when they experienced side effects after vaccination and hence a great number of cases were unreported. Referring to the AEFI data, the age group of 20-29 are the least reported age group among citizens which had 55 cases per 100,000 doses administered. Which shows the adverse effects of the vaccine are mostly underreported, failing to provide a comprehensive picture of the vaccine.

Data collection

Sampling size and survey invitation

With the prior approval from the local Institutional Review Board, the cross-sectional observational study was mainly carried out by an online questionnaire on the Qualtrics XM platform, to collect the anonymous self-reported symptom responses from our target audience.

The inclusion criteria of the target audience is as follows:

- Aged 18-30
- Have received one or two doses of BioNTech vaccination in Hong Kong
- Currently enrolled as undergraduate and postgraduate (full-time or part-time) students at any local universities or tertiary institutions

The interview survey commenced on 8 February 2022 and ended on 27 February 2022, with the duration of 19 days. The invitation link to the Qualtrics platform was held open and active throughout the entire survey period, and was sent via various popular social media and communication software, such as Whastapp, Signal and Facebook, and Instagram, etc.

A total of 450 invitation links were sent out to the potential participants who satisfied the recruitment criteria above, with 427 responding to the invitation. The responding participants were required to provide informed consent at the first page of the survey. Both the Chinese and English version of the study introduction and consent form were provided. 425 participants with informed consent then proceeded to the subsequent interviewing session, with 2 potential respondents withdrawing from the study.

Together with the subsequent screening and interview questions, a sampling size of 380 was included for the primary

and secondary analysis of this study, offering a complete response rate of 89.4% (see Figure 1). Unfortunately 10.6% participants providing incomplete responses were perceived as irrelevant and were filtered out from the study analysis.

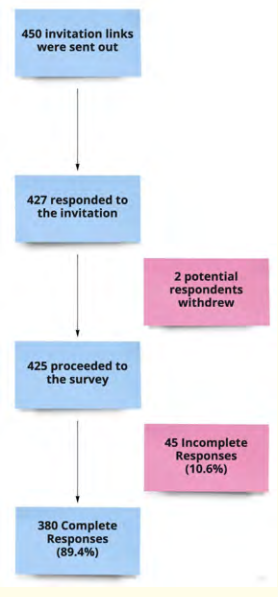

Figure 1: Classification Diagram of Complete Responses from the initial survey invitation.

Baseline demographics

In the first session of the online survey, basic background information of the respondents was collected, such as age, gender, educational status, general medical history and drug allergy, etc. However, all responses collected were held completely anonymous without any personal identifiers. With reference to diagram 1, the age distribution of the target respondents mainly lies between 18 to 24, suggesting that undergraduate students are the main source of respondents of our study.

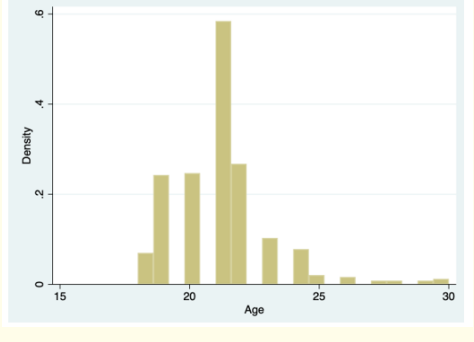

Diagram 1: Age Histogram of participants included for analysis.

Out of the 380 complete responses mentioned in Section 3.1.1, 323 participants received at least one dose of BioNTech vaccination. 215 (66.6%) participants received two doses at the time of the survey period while 3.4% and 30% received one and three doses respectively (Figure 2 and Diagram 2). Hence, the vaccination group is consistent with the primary outcome, i.e. ethnic Chinese aged 18-30 studying at local tertiary institutions receiving at least one dose of BioNTech vaccination.

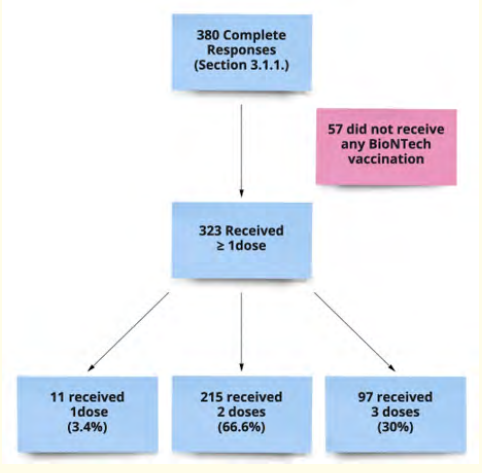

Figure 2: Classification Diagram of Injection Doses from Complete Responses.

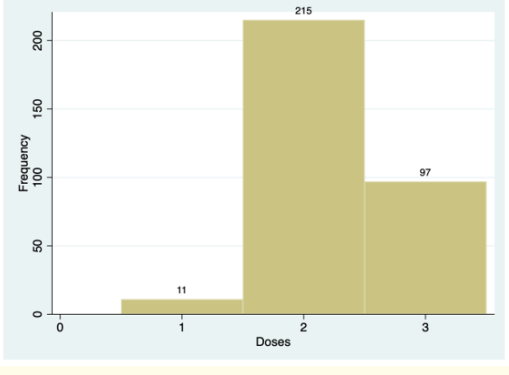

Diagram 2: Dose Histogram of participants.

The sampling group also shows a female-predominant pattern. Out of the 380 complete responses mentioned in Section 3.1.1, 69% respondents reported to be female while 31% reported to be male. With reference to Diagram 3, a vast majority of both male and female respondents received 2 doses of BioNTech vaccinations.

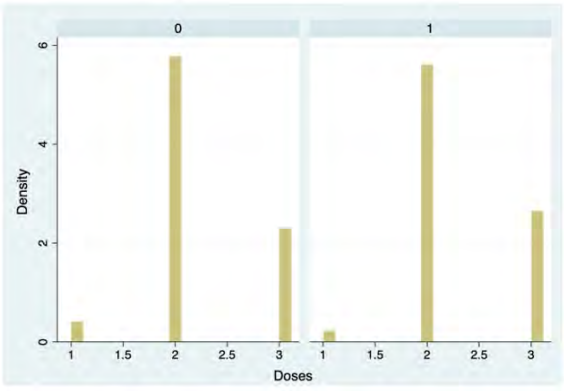

Diagram 3: Dose Histogram of participants stratified by sex (0 = male; 1 = female).

Furthermore, out of the 380 complete responses mentioned in Section 3.1.1, 317 respondents (83.4%) reported to be studying full-time undergraduate degrees, while 28 and 9 respondents reported to be studying associate degrees and postgraduate level respectively.

Pre-existing medical history and allergies

Since the background physical health of the target respondents is of great concern in relation to the potential side effects of the vaccination (e.g. anaphylaxis, disease predisposition and exacerbation), several general medical conditions, common allergies as well as smoking and drinking habits are listed in the preliminary interview section of the survey for reference.

Prior Medical Diseases	Prevalence in Sampling Group
Asthma	1.42%
Eczema	1.42%
Scoliosis	0.57%
Cardiac	1.14%
Respiratory	0.28%
Nephrotic	0.28%
Mental	0.57%

Table 1: Participants stratified by prior medical diseases.

Prior Allergies	Prevalence in Sampling Group
Drugs	2.31%
Seafood	2.60%
Diary	0.289%
Nuts	0.289%

Table 2: Participants stratified by prior allergies.

The medical conditions above would also be included in the subsequent multivariable analysis of the self-reported symptoms. Furthermore, 1.74% of participants reported to have chronic consumption of alcohol in their daily life while 5.79% reported to have cigarette smoking.

Statistical methods

The main purpose of the online questionnaire is to collect data about the self-reported symptoms of the participants and their perception of experiencing them. The frequency and severity of the symptoms is quantified into different scoring to enable subsequent symptom overview, data processing and multivariable analysis.

The data collected was then grouped according to their vaccination status, with group 1 receiving one dose of BioNTech and group 2 receiving two doses of BioNTech. They were further divided into subgroups according to their socio-demographic characteristics and backgrounds.

Multivariate logistic regression was performed to determine the association bwtween the side effects experienced after first dose and second dose of BioNTech, with different age, sex and chronic conditions. Multiple logistic regression was also performed to examine the association between duration of symptoms and actions taken after receiving the vaccine. Data analysis was processed using Stata 15.0.

Results

Self-reported symptoms after the first dose

The presence of side effects experienced by the target respondents are evaluated in the following parameters, including the types of systemic and localized symptoms, onset and duration of symptoms, the extent of daily life disturbance, the use of antipyretics and the need for hospitalization, etc. Furthermore, the vaccinated participants are stratified for statistical and multivariable analysis according to the number of doses of vaccination they had received.

Self-reported Symptoms of Participants just receiving One Dose

As mentioned in Section 3.1.2, there were 11 participants who had received only one dose of the BioNTech vaccination at the time of study. The most common symptoms include myalgia, fatigue, injection site irritation, and headache. Fortunately, no respondents reported to have severe adverse side effects, including insomnia, joint pain, palpitations and shortness of breath (Table 3).

Moreover, 9 participants reported that the symptom onset lasted for around one to three days, with moderate disturbance to their daily function. They also avoided strenuous physical exercise and alcohol one to three days after the injection.

Prior Medical Diseases	Number of participants
Fatigue	7
Myalgia	6
Injection site irritation	4
Headache	4
Dizziness	2
Nausea	1
Flushing	1
Fever	1
Chills	1

Table 3: Common symptoms experienced by the 11 participants just receiving the first dose.

Self-reported symptoms after first dose of participants receiving two doses

Similarly, from Section 3.1.2, there were 215 participants (66.6% of the total vaccination group) who had received 2 doses of BioNTech vaccination at the time of study. The participants were required to recall the symptoms and side effects they experienced at the time soon after the first dose. The most common symptoms experienced by the participants were myalgia (70.75%), fatigue (64.45%), injection site irritation (56.40%) and soreness (40.28%) respectively, which are relatively consistent and similar to common side effects as observed in mass media and public report sources. 3 respondents reported experiencing allergic-like reactions (rash, urticaria) but the symptoms were resolved after 1-3 days.

Symptoms after 1st dose of BNT162b2 vaccine (had received 2 doses)	Percentage reported (%)	Number of responded (n)
Generalized symptom/s		
Fatigue	64.45%	136
Fever	14.22%	30
Dizziness	8.06%	17
Chills	9.00%	19
Sweating	3.32%	7
Flushing	1.90%	4
Localized symptom/s		
Injection site reaction	56.40%	119
Soreness	40.28%	85
Musculoskeletal symptom/s		
Myalgia	70.75%	150
Joint pain	3.79%	8
Spasm	0.474%	1
Gastrointestinal symptom/s		
Nausea	3.32%	7
Cardiovascular symptom/s		
Palpitation	2.84%	6
Respiratory symptom/s		
Shortness of breath	0.948%	2
Psychological symptom/s		
Insomnia	0.474%	1

Table 4: Common symptoms experienced by the 215 two-dosed participants after the first dose.

Furthermore, the participants presented with fever above had used antipyretics for alleviating the discomfort, and there were 13 and 23 participants who avoided strenuous physical exercise and alcohol consumption one to three days after the injection respectively. However, there were 3 participants who did not take any actions in avoiding the potential side effects. 196 participants reported mild to large extent of disturbance to their daily functioning. A vast majority of the self-reported symptoms from above lasted one to three days after the first dose of injection.

Self-reported Symptoms after Second Dose

Self-reported symptoms after second dose of participants receiving two doses

From Section 3.1.2, 215 participants had received two doses of BioNTech vaccination. Nonetheless, only 207 participants reported their side effect of the second dose in the study. The most common reported symptoms includes Myalgia (76.81%), Fatigue (66.67%), Injection site reaction (54.57%), Fever (44.44%) and Soreness (43.96%) which are similar to the side effects as observed in the first dose of vaccination. 1 respondent reported of experiencing enlargement of a lymph node, 3 respondents experienced allergic reactions with rash or urticaria, while 1 respondent reported experiencing an anaphylactic reaction and urticaria.

After the second dose vaccination, The most reported intervention to relieve the symptoms are taking a rest at home and only one of the participants needed further treatment. There were 91 participants (35%) who had used antipyretics to relieve discomfort. 7 participants (3.4%) consumed alcohol and performed strenuous exercise after the second dose of vaccination respectively. Majority of participants reported the symptoms lasted one to three days and thought the side effects of vaccination have mild to large extent affecting their daily functioning.

Association between duration of symptoms and actions taken by participants

Multivariate logistic regression is performed to examine the association between the duration of symptoms after the second dose of BioNTech and the actions the participants had taken after the second dose of BioNTech, such as taking antipyretic and performing strenuous activity. When comparing the duration of symptoms and whether participants had taken antipyretic after the second dose, we obtained a p-value of 0.001, which shows a statistical significance for taking antipyretic after the second dose. When comparing duration of symptoms with whether participants had performed strenuous activity after the second dose, we obtained a p-value of 0.036, which also shows a statistical significance for doing strenuous exercise after the second dose of BioNTech.

Symptoms after 2nd dose of BNT162b2 vaccine (had received 2 doses)	Percentage reported (%)	Number of responded (n)
Generalized symptom/s		
Fatigue	66.67%	138
Fever	44.44%	92
Headache	33.33%	69
Dizziness	19.81%	41
Chills	15.46%	32
Sweating	10.63%	22
Flushing	2.99%	6
Localized symptom/s		
Injection site reaction	54.57%	113
Soreness	43.96%	91
Musculoskeletal symptom/s		
Myalgia	76.81%	159
Joint pain	3.38%	7
Spasm	0.48%	1
Gastrointestinal symptom/s		
Nausea	6.28%	13
Cardiovascular symptom/s		
Palpitation	1.93%	4
Respiratory symptom/s		
Shortness of breath	1.0%	2
Psychological symptom/s		
Insomnia	0.48%	1

Table 5: Common symptoms experienced by the 207 two-dosed participants after the second dose.

Secondary analyses

The association self-reported symptoms after first dose and prior medical history

With reference to the baseline demographics and chronic illness prevalence in Section 3.1.2 and 3.1.3 respectively, a multivariable regression was conducted to evaluate the correlation between prior medical history and against the listed side effects. Using myalgia after the first dose as an example, it was found that asthma and prior mental status imposed a higher risk in developing the symptom

presented, as compared to respiratory and nephrotic disorders, other chronic diseases and nut allergy, whose confidence interval overlapped with the vertical zero line (Diagram 4). Furthermore, with the statistical significance of p-value < 0.1, it is deduced that local patients (age of 18 to 30) suffering from asthma and mental problems are more prone to develop myalgia, as compared to other healthy individuals present in the vaccination group.

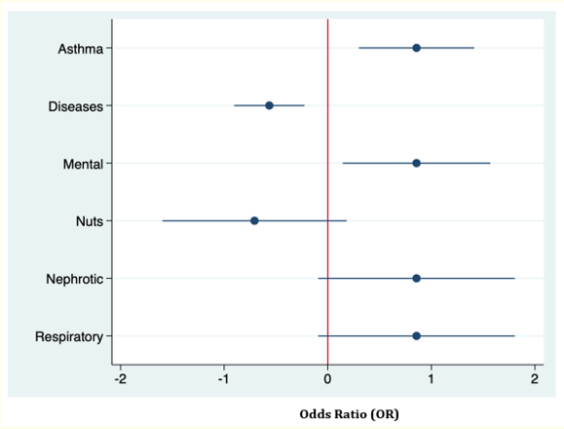

Diagram 4: Forest Plots illustrating the confidence interval distribution of each symptom outcome against Risk Ratio.

Furthermore, another set of multivariate regression was performed to evaluate the causal linkage between prior medical conditions and soreness. Chronic diseases beyond asthma, respiratory and nephrotic disorders mentioned above also imposed a causal linkage with the presentation of soreness after the first dose, with a statistically significance of p-value < 0.1.

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. regress Myalgia1 Asthma Diseases Mental Nuts Nephrotic Respiratory
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Source	SS	df	MS	Number of obs	=	320
				F(6, 313)	=	2.78
Model	3.3987782	6	.566463033	Prob > F	=	0.0120
Residual	63.8012218	313	.203837769	R-squared	=	0.0506
				Adj R-squared	=	0.0324
Total	67.2	319	.210658307	Root MSE	=	.45148

Myalgia1	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
Asthma	.8571429	.2829826	3.03	0.003	.3003543	1.413931
Diseases	-.5643797	.1725984	-3.27	0.001	-.9039794	-.22478
Mental	.8571429	.3619925	2.37	0.018	.1448966	1.569389
Nuts	-.7072368	.4522259	-1.56	0.119	-1.597024	.1825502
Nephrotic	.8571429	.4826567	1.78	0.077	-.0925189	1.806805
Respiratory	.8571429	.4826567	1.78	0.077	-.0925189	1.806805
_cons	.7072368	.0258944	27.31	0.000	.6562878	.7581859

Figure a

Association between gender and the extent of impact of symptoms on daily functioning

In the questionnaire, the degree of symptoms affecting participants' daily functioning was asked, and the result of male and female is being compared. From the result, female participants show a higher affection of daily functioning by the symptoms brought by the vaccine when compared with male participants. It is hypothesized that it could be due to a lower pain tolerance in females, but further research is needed to explore such correlation.

Discussion

This study aimed to investigate and present the underreported side effects of the BNT162b2 vaccine among university students aged 18-30 in Hong Kong, by comparing the primarily collected data with the various public data sources so as to visualize the information gap of symptom reporting. The post-vaccination symptoms of the two doses were collected through an online questionnaire. It should be noted that only the symptoms of the 1st and 2nd dose of BNT162b2 were investigated, the symptoms of the 3rd dose were not examined as the study was designed before the administration of the 3rd dose in Hong Kong.

In Hong Kong, a city-wide COVID-19 vaccination program was launched, the interval between the two doses of BioNTech for adults aged 18 or above was set to be at least 21 days and as early as possible by the Center for Health Protection [11], which was in line with the guideline suggested by the CDC [12]. To ensure the continued safety of the vaccine, The Department of Health had established a dedicated COVID-19 Vaccine Adverse Event Online Reporting System after the launch of the city-wide vaccination program and encouraged healthcare providers to report any serious adverse event following immunization (AEFI) of COVID-19 vaccine, which includes but is not limited to allergic reactions, systemic reactions and neurological disorders [13].

Based on the survey results, the most common side effects reported in the two doses were similar: generalized symptoms (fatigue and fever), localized symptoms (injection site reactions, soreness), and myalgia. Other predominant symptoms included: dizziness, chills, headache, nausea, diarrhea palpitations, joint pain, flushing and sweating. Majority of symptoms reported in both doses occurred within 4-8 hours and resolved in 1-3 days by resting at home, showing the symptoms were resolvable, self-limiting and short-lasting.

Symptoms-relieving medications such as antipyretics and painkillers were encouraged to be used to resolve post-vaccination symptoms, and as expected, it was found that 16.5% and 35.5% of respondents reported having used such medications after the 1st dose and 2nd respectively, which could a possible confounding factor of the short-lasting and self-limiting features presented above.

Symptoms such as insomnia, decrease in hearing, chest pain, lymphadenopathy, polyphagia, and sore throat were reported by some respondents but at a low frequency for each symptom (<1% of total responses). Since those reactions were reported by the students themselves, predisposing conditions and factors could exist that can confound the interpretations of these symptoms. Hence, more thorough investigations are needed before conclusions could be made as to the association between those symptoms and the vaccine.

Any allergic or anaphylactic reactions could be life-threatening, while such reactions in COVID-19 vaccines usually occur shortly after vaccination, the CDC recommends people who are allergic to Polyethylene Glycol (PEG) to not receive the mRNA vaccine, but recommends people who have allergies that are not related to any injectable medications i.e. food, environmental, latex, to still get vaccinated [14]. It had also recommended an observation period of 30 minutes to recipients who have a history of allergic reactions to the previous dose of COVID-19 vaccine or any injectable treatment and an observation period of 15 minutes to all other persons, such observation periods could provide early and timely recognition, assessment, and treatment for vaccine recipients. In Hong Kong, the Centre for Health Protection had adopted such guidelines as well[11]; a thorough history of any medication allergies and previous vaccine reactions would be taken before the administration of COVID-19 vaccines at any community vaccination centers. In the survey, among the responses, 3 respondents reported experiencing allergic-like reactions (rash, urticaria) after the 1st dose while 3 respondents experienced such reactions after the 2nd dose. Since none of them had a known history of allergy to medications or food, it's difficult to comment on the relationship between such reactions and the vaccine. 1 respondent with a seafood allergy reported experiencing an anaphylactic reaction and urticaria after the 2nd dose, while experiencing no allergic reaction to the previous dose, the respondent was then hospitalized for 5 days with a treatment of adrenaline, hydrocortisone and piriton.

The primary objective of this study is to visualize the possible information gap in post-vaccination symptom reporting in Hong Kong. In some overseas studies and recommendations [4,15], it was reported that the most common local and systemic reactogenicity that BNT162b2 recipients experienced were local site reaction (redness, swelling), soreness, fever, chills, myalgia fatigue and headache, while symptoms such as lymphadenopathy, hyperhidrosis, difficulty sleeping, being relatively less likely to occur; such results were consistent with the findings of this study. Local studies in Hong Kong were favorable for the comparison of this study to see if the results were homogenous. However, only a few official reports from the government could be found regarding AEFI, the most commonly reported AEFIs that were rare yet concerning were chest discomfort, dizziness, chest pain and palpitations [16], which were homogenous with minor results in this study. A fact sheet provided by the Department of Health and Centre for Health Protection [17] has listed the possible side effects post-vaccination, the most common ones include injection site reactions, myalgia, fatigue, fever, joint pain and muscle pain; the less common ones listed are lymphadenopathy, hyperhidrosis etc., the symptoms listed are similar to the ones described in the aforementioned studies and recommendations. Yet, there are insufficient local studies and official sources that could be used for comparing the actual figures of the more common and non-serious symptoms found in this study, further demonstrating the gap in symptom reporting.

As presented in Part 5, sets of multivariate regression were conducted to examine the correlation between prior medical history and the listed side effects and the correlation between sex and the extent of impact of symptoms on daily functioning. It was found that patients suffering from asthma and mental problems were more prone to developing myalgia; while patients with chronic conditions such as asthma, respiratory and nephrotic disorders also imposed a causal linkage with the presentation of soreness. However, to date, there is a lack of data that could explain the correlations mentioned above. Besides, female respondents were found to be correlated with a higher degree of self-reported impact on daily functioning post-vaccination, this could be explained by the differences in hormonal, psychosocial mechanisms (coping mechanisms), sociocultural beliefs and previous environmental stress in the two genders [18] leading to a different degree of tolerance to side effects, pain sensitivity or the number/severity

of side effects occurred. Since this correlation could be due to a number of factors (as examplified above), a definite conclusion and explanation could not be made on the correlation between sex and the impact of side effects post-vaccination.

Implications and recommendations

Even though the findings in this study are congruent with existing studies, there is a need to further monitor the safety of this newly-developed vaccine especially with the administration of the 3rd and 4th dose, as the safety profile of the COVID-19 vaccine could lead to vaccine hesitancy. The lack of post-vaccination data in Hong Kong also demonstrated there is a gap in symptom reporting, this could be due to a limited number of local channels for citizens to report their symptoms, insufficient education and knowledge on adverse effects and how to handle them; healthcare professionals were encouraged to report serious adverse events only instead of minor ones (presented in this study). To ensure the safety of this vaccine and the confidence of citizens on this vaccine, more accessible reporting channels and education should be provided to the public to encourage reporting of symptoms in order to further visualize the information gap. Long-term city-wide research studies by the government officials or local academies concerning side effects of the 4 doses should be conducted and promoted to ensure the safety of the vaccines, data gathered could also be used for cross-comparison studies that are similar to this study, which could help increase the transparency of vaccine-related issues and hence the rate of vaccination in the city.

Limitations

There are several limitations in this study. The results of this study relied solely on the self-reported data provided by the respondents anonymously, the responses had no way to be assessed or verified, questions regarding the symptoms were asked but specific data of each reported symptom (i.e. characteristics, predisposing, aggravating factors) was not inquired, which might render the responses subjective and biased as there might be other factors contributing to the symptoms other than the vaccine itself. Another limitation is the distribution period of this study, the study was designed in September 2021, which was the time where most citizens in Hong Kong received the first two doses, but with the time needed for ethics review and approval, the questionnaire was distributed in February 2022, which was also the period where the 3rd dose of the vaccine was promoted and administered; such a discrepancy might lead to recall bias of symptoms of the 1st and 2nd doses by the respondents, threatening the internal validity. Response rate, representativeness and demographic characteristics of the study might affect the quality of data analysis and results. As presented in Figure, it was shown that 10.6% of the responses were incomplete and hence filtered out from data analysis, but the excluded data could potentially affect the results of the study; According to Part 3.1.2, the baseline demographics of the respondents, 69% of respondents were female while the age distribution of respondents lies mainly on 18-24 years old, note that the target age group of this study is 18-30. Such biases in age and sex might confound and influence the quality of the data and findings; the biases could be due to the development of the pandemic, only online recruitment of participants was possible, random on-site recruitment in local universities was unattainable. A systematic review [19] showed that people with immunocompromising conditions such as those undergoing dialysis or chemotherapy had a different immune response towards the vaccine, the questionnaire in this study had also designed questions for immunocompromised individuals, but there was no respondent responding of having such conditions, causing a lack of representation for this group of individuals. The most significant limitation in this study was the lack of local studies and data for the comparison of findings to see if they were homogenous, which was the primary aim of this study.

Conclusions

The study found that the most common self-reported symptoms post-vaccination in local university students aged 18-30 were localized site reaction, soreness, fatigue, myalgia and fever, which where all minor, non-life threatening, short-living, self-limiting, reactogenic and could be resolved by the use of symptom-relieving medications. Allergic or anaphylactic reactions were reported by some respondents but the occurrence was low, the cases were resolvable through suitable treatments provided and advised by healthcare professionals at home or at hospital. The findings indicated that the symptoms reported by the participants were homogenous with existing studies and guidelines overseas, which could be useful for assessing and proving the safety of the vaccine locally. Majority of respondents had received the second or the third dose by the time they completed the questionnaire,

indicating most university students were still determined to get fully vaccinated and protected despite the possible symptoms post-vaccination. Correlations between different chronic conditions and specific symptoms (myalgia or soreness) were analyzed but further investigations and literature are needed to explain the relationship shown. Gender was also found to be correlated with the perceived impact of symptoms on daily functioning but various factors could be behind this correlation, so no definite conclusions could be made. The study was able to fulfill the aim of visualizing the information gap of self-reported vaccine side effects in Hong Kong; However, further policies and studies are needed to narrow the gap to inform and protect vaccine recipients in the long-run.

Ethical Approval

The study and other relevant documents had been reviewed and approved by the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster (HKU/HA HKW IRB) before the study was initiated.

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