ORIGINAL ARTICLE

Effect of SARS-CoV-2 Infection on Vaccine Induced Antibody Production among Some Healthcare Personnel of Bangladesh Medical University, Dhaka

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ABSTRACT

Background: Bangladesh has started administration of covid-19 vaccine with the Oxford AstraZeneca on 27th January, 2021 while the mass vaccination started on 7th, February, 2021. Aim of this study was to observe the difference of antibody levels achieved by vaccination in Covid-19 infected and non-infected individuals.

Methods: This cross sectional, observational study was conducted at the Department of Biochemistry and Molecular Biology, Bangladesh Medical university (BMU) Dhaka, (former Bangabandhu Sheikh Mujib Medical University), Bangladesh, between March 2021 and February, 2022. A total 70 adult participants (healthcare personnel) were included in this study who were working in different departments of BMU hospital. Study participants were categorized into two groups: healthcare personnel who were infected by SARS-CoV-2 and later vaccinated by two doses of AstraZeneca Covid-19 vaccine were included group A, while group B included those who were not infected by SARS-CoV-2 but two took two doses of AstraZeneca Covid-19 vaccine. Each group had 35 participants. Demographic profile, detailed history was recorded in data collection sheet. Serum IgG was assessed by chemiluminescent microparticle immunoassay method.

Results: Age range of the participants was 25 to 65 years. Respondents of all age groups who were infected and vaccinated showed significant level of antibody titer young aged (25-35 years): IgG-1700 AU/ml & p=0.001, middle aged (35-45 years): IgG=3141 AU/ml & p=0.006, elder aged (45-55 years): IgG=2183AU/ml, p=0.007, old aged (55-65 years) IgG=3761 AU/ml, p=0.001 compared to non-infected vaccinated young aged: IgG=459AU/ml, middle aged (35-45 years): IgG=663AU/ml, elder aged: IgG=739 AU/ml old aged: IgG=616 AU/ml. on the other hand, both male and female healthcare personnel who were vaccinated at the same time infected as well, shows comparatively increased IgG compared to those who were vaccinated but not infected male:IgG-776 AU/ml, female: IgG-349 AU/ml & among those two groups, males revealed increased IgG status than females male: IgG=2654 AU/ml & p=0.001, female IgG-1700 AU/ml, p=0.001. Lastly, professions, both infected vaccinated doctors, & nurses shows an increase in IgG, doctors: IgG-2243AU/ml p=0.001 & nurses IgG-2183 AU/ml & p=0.001 compared to those who were non-infected vaccinated doctors IgG=610 AU/ml & nurses IgG=661 AU/ml in this current study. Similarly, among participants with no comorbidities significant differences in IgG levels were observed (group a median 2394.45 AU/ml and IQR 3450.73 AU/ml; group B median 653.10 AU/ml and IQR 990.13 AU/ml (p<0.001).

Conclusion: Antibody levels achieved after vaccination (serum IgG levels) was significantly higher in previously Covid-19 infected vaccinated group (irrespective of age, sex & professions) than that of non-infected vaccinated group.

Keywords: SARS-CoV-2 infection, Covid-19 vaccination, Antibody status.

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INTRODUCTION

The Coronavirus disease outbreak was first reported in Wuhan, Hubei, China, in December 2019 that was undoubtedly faced by whole world as severe acute respiratory syndrome caused by the novel Coronavirus 'SARS-CoV-2'.[1,2] Covid-19 spread globally with increasing morbidity and mortality[3]. The World Health Organization assessed Coronavirus outbreak and its

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alarming levels of spread and declared Covid-19 as a global pandemic on March 11, 2020.[4] SARS-CoV-2 is a highly transmissible infection that threatens to human life & safety; millions of life had been lost globally due to SARS-CoV-2 where men were more vulnerable than women.[5,6]

Accordingly, the only strategy to protect the human being from the curse of Covid-19 is producing sufficient antibody either by low level passive exposure or vaccination or both.[7] Antibody titers following single dose of vaccine in previously SARS-CoV-2 infected participants were greater than those of not infected previously but have received even two doses of vaccine.[8] Antibody plays a vital role in suppressing the pathogenesis of SARS-CoV-2 by disrupting the binding of viral spike protein to angiotensin-conveting-enzyme2 receptor on the target cell.[9] Country-wide vaccination for the prevention of this disease started on 7th February 2021. Government published a priority list for the first round of vaccine recipients including frontline workers and older aged.[10]

Bangladesh after administration first dose of Oxford AstraZeneca vaccine showed that in infected group antibody titers was six times higher than the uninfected ones.[11] Hence, priority for Covid-19 vaccination was given to the elderly, frontline workers & those with compromised immunity, as they were higher risk of severe illness.

Therefore, this was planned to evaluate and compare the antibody status between SARS-CoV-2 infected vaccinated & non-infected vaccinated healthcare personnel.

METHODS & MATERIALS

This cross-sectional observational study was conducted at the Department of Biochemistry & Molecular Biology, Bangladesh Medical University (BMU), (former Bangabandhu Sheikh Mujib Medical University, BSMMU) Dhaka Bangladesh, between March 2021 & February, 2022.

Inclusion criteria

- Age: 25 to 65 years.
- Gender: Both male and female
- Healthcare personnel who were SARS-CoV-2 infected last 8-12 months ago (RT-PCR positive report) & received two doses of AstraZeneca Covid-19 vaccine last 4 to 6 months ago.
- Healthcare personnel who were SARS-CoV-2 not infected but vaccinated by two doses of AstraZeneca vaccine last 4 to 6 months ago.

Exclusion criteria:

- Subject with acute infection.
- Pregnant women.
- Lactating mother
- Heart failure
- Subject having systemic disease like chronic liver disease, chronic kidney disease.
- Diagnosed endocrine disorder like thyroid disorder.
- Subject who are suffering from any immune-suppressive disorder like cancer, SLE.

Based on inclusion and exclusion criteria, a total of 70 healthcare personnel were included in this study from different departments of BMU hospital. Study participants were categorized into two groups:

Group A - healthcare personnel who were previously infected by SARS-CoV-2 and later vaccinated by two doses of AstraZeneca Covid-19 vaccine.

Group B- healthcare personnel who were not infected by SARS-CoV-2 but received the same dose of AstraZeneca Covid-19 vaccine.

They were categorized as young aged (25-35 years), middle aged (35-45 years): IgG=3141 AU/ml & p=0.006, elder aged (45-55 years): IgG=2183AU/ml, p=0.007, old aged (55-65 years)

There were 35 participants in each group. A data collection sheet was used as data collection tool. With all aseptic precaution, 5ml blood sample was collected from the anti-cubital vein. 2ml of blood was delivered immediately into sodium fluoride tube (grey top tube) and 3ml into a plain tube (red top tube). All the test tubes were centrifuged to separated serum that was taken in Eppendorf tube, properly labeled and stored at minus -65^0C temperature. Estimation of serum IgG levels was done using chemiluminescent microparticle immunoassay in Abbot Alinity I Autoanalyzer (made by Abbot Inc. USA). All immunological assays were performed in the Department of Biochemistry & Molecular Biology of Bangladesh Medical University (BMU).

Continuous variables were expressed as Mean±SD and compared between groups using unpaired student's t-test. Categorical variables were expressed as frequency & percentage and compared using Chi-square test.

Mann-Whitney U test was done to compare serum IgG levels in between SARS-CoV-2 infected vaccinated group and SARS-CoV-2 non-infected vaccinated group. Level of significance was defined as p-value <0.05 (at 95% confidence interval). Statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 20.0 for windows. Ethical clearance was obtained from the Institutional Review Board (IRB) of Bangladesh Medical University (BMU), Dhaka, Bangladesh.

RESULTS

The mean age of previously infected and vaccinated individuals (group A) was 41.14±12.51, while 38.43±9.18 years for not infected but vaccinated individuals (group B). However, there was no significant difference in age between the groups (p>0.05). A male predominance was observed in group A; conversely, female predominance was found in group B. The difference in gender between the groups was statistically significant (p<0.05). In group A, there were 40% doctors and 60% nurses while, in group B, there were 65.7% doctors and 34.3% nurses. Significant difference was observed between the groups (p> 0.05) (Table-1).

Respondents of all age groups who were infected-vaccinated showed significant level of antibody titer young aged: IgG-1700 AU/ml & p=0.001, middle aged: IgG=3141 AU/ml & p=0.006, elder aged: IgG=2183AU/ml, p=0.007, old aged IgG=3761 AU/ml, p=0.001 compared to non-infected vaccinated young aged: IgG=459AU/ml, middle aged: IgG=663AU/ml, elder aged: IgG=739 AU/ml old aged: IgG=616 AU/ml.

On the other hand, both male and female health personnel who were vaccinated at the same time infected as well, shows comparatively increased IgG compared to those who were vaccinated but not infected male: IgG-776 AU/ml, female: IgG-349 AU/ml; and, among those two groups, males revealed increased IgG status than females male: IgG=2654 AU/ml & p=0.001, female IgG-1700 AU/ml, p=0.001.

Lastly, professions, both infected vaccinated doctors and nurses shows an increase in IgG; doctors: IgG-2243AU/ml, p=0.001 and nurses IgG-2183 AU/ml, p=0.001 compared to those who were non-infected vaccinated doctors IgG=610 AU/ml and nurses IgG=661 AU/ml in this current study (Figure-1). Similarly, among participants with no comorbidities significant differences in serum IgG levels were observed group A median 2394.45 AU/ml and IQR 3450.73 AU/ml; group B median 653.10 AU/ml and IQR 990.13 AU/ml, (p<0.001) (Table-2).

Table 1: Demographic characteristics of the study participants (n=70)

Variables	Group-A n=35	Group-B n=35	p-value
Age in years			
Mean±SD	41.14±12.51	38.43±9.18	>0.05NS
Gender			
Male	24 (68.6)	14 (40.0)	<0.05 S
Female	11 (31.4)	21 (60.0)	
Occupation			
Doctor	14 (40.0)	23 (65.7)	<0.05 S
Nurse	21 (60.0)	12 (34.3)	

Table 2: Antibody status (serum IgG) of the study subjects with and without co-morbidity.

Variables	Antibody Status (AU/ml)	Group-A (n=35)	Group-B (n=35)	p-value
With Co-morbidity (n=26)	Median	2183.20	624.70	<0.001S
	IQR	4095.70	558.80	
	Min-max	897.30 - 8797.60	99.40-1393.90	
Without Co-morbidity n=44	Median	2394.45	653.10	<0.001S
	IQR	3450.73	990.13	
	Min-max	861.70- 12884.10	96.10-2330.00	

Data were expressed as median and IQR (Inter quartile range). The p value reached from Mann Whitney U test; S=significant.

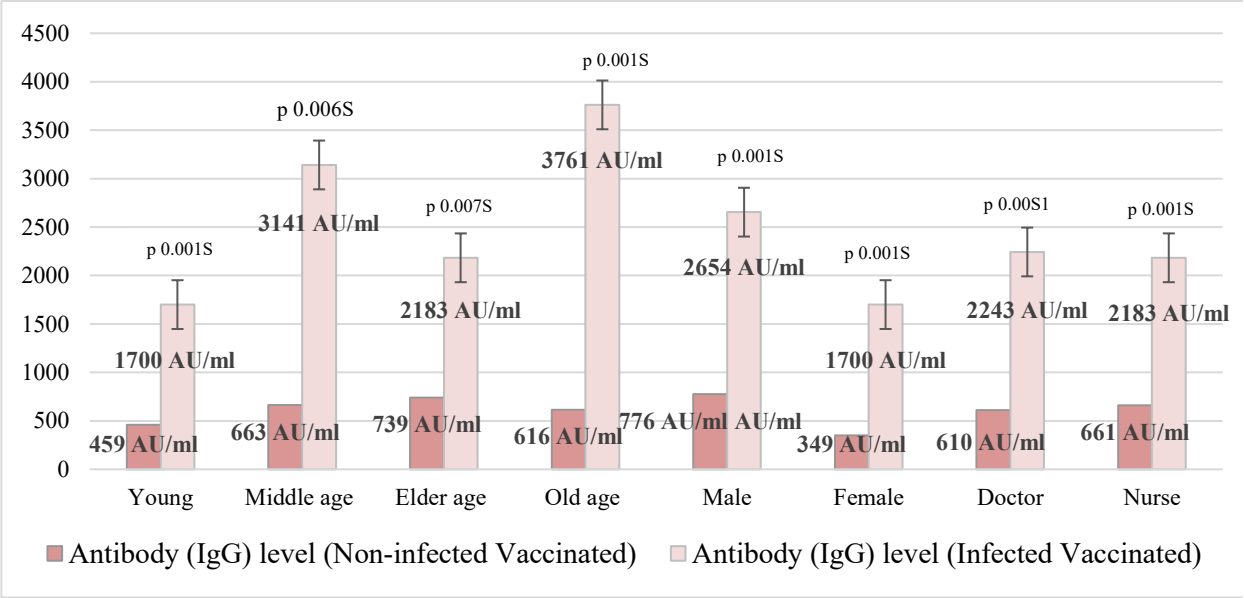

Fig 1: Level of Antibody (IgG) in different sociodemographic characteristics between infected vaccinated & non-infected vaccinated (n=70). The p-value reached from Mann-Whitney U test; S=significant.
[*** Antibody titer (IgG >50 AU/ml) is revealed to be a cut-off point as a significant antibody marker]

Continuous variable were expressed as mean±SD, while categorical variables were expressed as frequency and percentage. Unpaired students t-test was to compare differences in age, while Chi-square test was used to compare gender and occupation. S=significant, NS=not significant.

DISCUSSION

The vaccines act by generating anti S protein IgG and virus specific neutralizing antibody which neutralized SARS-CoV-2 infection.[12] Antibody plays a vital role in suppressing the pathogenesis of SARS-CoV-2 by disrupting the binding of viral spike protein to angiotensin-conveting-enzyme2 receptor on the target cell.[13] A study was done in Ziekenhuis Oost Limburg Hospital among the health worker in Belgium represented that previously infected vaccinated participants had higher antibody titer GMT 9461 U/mL compared with previously uninfected vaccinated participants GMT 1613 U/mL.[14] A cross sectional study occurred over population of Bangladesh after administration of first dose of Oxford AstraZeneca demonstrated that convalescent group showed six times higher antibody titer than the uninfected ones.[15]

A study in London's found that after single dose of vaccine there was a significant difference in antibody levels but the disparities did not persist after second dose; high level antibody titer ≥250 U/ml observed for all ages.[16] A study in Bangladesh showed that 95% of individuals developed IgG response after SARS-CoV-2 infection.[17] Previously SARS-CoV-2 infected person with presence of anti-spike and anti-nucleocapsid IgG antibody associated with reduced risk of SARS-CoV-2 reinfection for at least 6 months.[18] An Italian observational study showed that highest levels of IgG and IgA were produced by patients with severe disease.[19] In the mild, severe and critical groups IgG was detected 90.6%, 92.7% and 88%.[5] IgG responses may be different in children and adolescents compared with those in adults. Anti-SARS-CoV-2 antibody (IgG) is more robust in children than adult.[20] A prospective cohort study in UK found that previously SARS-CoV-2 infected individuals were at 83% lower risk of infection and the protective effect observed for five months following primary infection.[21] A cohort study in Northeast Portugal reported that previously infected and vaccinated group expressed higher median IgG values 13,911.0 AU/ml and previously non-infected vaccinated group expressed lower median IgG level 5158.7 AU/ml in respect of age gender and category.[22] Our result are in congruence with those findings.

We evaluated the antibody status of patients with comorbidities and patients without comorbidities in between infected vaccinated and non-infected vaccinated group; we found higher antibody level in infected vaccinated (2183.20 Au/ml) group than in

non-infected vaccinated group (624.70 AU/ml). A cohort study in Kuwait, serum IgG level after three weeks of second dose of vaccine was 138 BAU/ml in diabetic participants whereas, in non-diabetic participants that was 154 BAU/ml. The study also found serum IgG in hypertensive individuals was 144 BAU/ml and in non-hypertensive individuals was 151 BAU/ml which were relatively lower.[23]

We found that among infected vaccinated group 24 (68.6%) were male and 11 (31.4%) were female whereas, in non-infected vaccinated subjects 14 (40.0%) were male and 21(60.0%) were females. Another cross sectional study in US metropolitan suggested that males were more infected than females (17% vs 14.6%).[24] In our study we found that among the healthcare personnel 60.0% were infected. A retrospective cross sectional study in Iran's reported that majority of infected case were among nurses (51.3%).[25]

Conclusion

Come to an end, antibody status (serum IgG) was found significantly higher in previously infected vaccinated group (group A) compare to non-infected vaccinated group (group B).

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Conflict of interest

The authors declare no conflict of interest.

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