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Research Article

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Effect of Food Allergy among Patients Affected by Delta and Omicron Variants-A Case Study

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Abstract

Background: *The variants of SARS-CoV-2 have been affecting people globally since 2020. The Delta variant, mainly in India and the omicron variant in multiple countries since Nov 2021, has infected millions of people; many died out of them. Amongst all factors, food allergy is one factor that also accelerates many infected people's comorbidities and overall health status during the pandemic.*

Aims: *The study aimed to assess the role of some common food allergies in Delta and Omicron infected people in the Indian population.*

Methods: *The study was designed with 50 covid positive home-isolated patients (out of 62) infected by both the mentioned variants from April 2021 until 15th January 2022. However, they were not severely ill but had comorbidities such as diabetes, obesity, hepatomegaly, etc. After the negative test result, each participant was requested to attend a telephonic interview for 15 minutes. Further, they were offered free online diet consultation considering the fatigue and some allergic symptoms. ATLAS-Ti-9 software was used for the fundamental analysis.*

Results: *Based on their self-referred serological allergy test (SAT), we found that 23 samples of milk (46%), 14 (28%) samples of citrus fruits, 12 (24%) patients were allergic due to mustard oil and other detections too based on the positive interpretation (+ to +++) of specific IgE (IU/ml). The patients were facing type-1 hypersensitivity but no other severe allergic issues.*

Conclusions: *Food allergy accelerated respiratory syndromes and comorbidities, mainly among the infected (Delta and Omicron) patients who could also have a high chance of hypersensitivity due to some common ingesting allergens.*

Keywords: Delta Variant, Omicron Variant, Food Allergy, Allergens, Comorbidities, Hypersensitivity, Immunity,

Introduction

Various allergies caused by food, environment, pets are becoming major health concerns globally. India is one of the affected countries where many people suffer from hypersensitivity due to different allergens that affect internal cum external human organs. Current data shows that clinicians nowadays focus more on these issues in their clinics and research centers to identify or discover various drugs, supplements for better immunity, and vaccines as a preventive approach [1].

Allergens and IgE: The importance of epitopes (antigenic determinant) in the therapeutic cum diagnostic field has become more essential to assess and determine the nature of allergens specificity, sensitivity, mechanisms, reproductions, interaction with other compounds. Here is the need for customized assessment, diagnosis followed by interventions, and monitoring until the patient's stable allergic status [2]. Serum IgE is tested by the specific methods as per antigen-antibody reaction that is enzyme-linked immunosorbent assay (ELISA), fluorescence enzyme immune assay (FEIA), and radio allegro sorbent test (RAST). In

general, the healthy control's serum level of IgE falls under 1micro gram/ml, but in the case of the atopic condition, the level usually becomes high than average [3]. A study showed that around 8% of children and 4% adult population are affected by IgE-mediated food allergy. Food allergy causes mild to severe hypersensitivity in the G.I tract, acute urticaria, atopic dermatitis, and anaphylaxis, leading to loss of life [4, 5]. Almost 12% of Indians have been affected with bronchial asthma, allergic rhinitis, or both in recent years, where food allergy is indirectly correlated. Egg, cereals, milk, and legumes are the most common causative factors for IgE-mediated reactions among children and adults [6, 7].

Effects of Covid-19: The covid-19 or coronavirus is one of the most severe pandemics that has already affected a large number of the global population since the end of 2019. More than 352 million confirmed positive covid cases, and 5.6 million deaths were reported in 200 countries by the end of the 3rd week of January 2022, as per data from WHO. People from all across the world are at a severe stage during these pandemic days. Hence, all need to be focused on preventing the transmission by following the appropriate covid behavior. As per tracking since 2020, there are faster-spreading and quickly transmissible variants of the SARS-CoV-2 virus that may cause COVID-19 infections more severe. In December 2020, the Beta (B.1.351) variant was identified in South Africa and another Alpha (B.1.1.7) in the United Kingdom, and in both, one change in common, i.e., N501Y mutation (VOC 202012/01 and VOC 202012/02) [8].

Impacts of Covid variants: In the 2nd wave, in India and other countries such as the UK, US, China, Japan, Poland, Portugal, Switzerland, Nepal, and Russia, the Delta variant was identified as a deadly variant. The studies showed that the variant could use powerful binding to the lung. The cell receptors significantly reduce monoclonal antibody response. In India in December 2020, the Kappa variant of SARs-COV-2 virus was first identified, which is a double mutant strain of the virus called B.1.167.1 scientifically. B.1.617.3 is a part of the Delta variant B.1.617.2, responsible for the second wave. The recent variant termed as Omicron (B.1.1.529) variant was first reported on 24 November 2021 from South Africa, and that was declared a variant of concern (VOC) by the World Health Organization. Altogether omicron variant was considered theoretically 'mild' so far, but infection and transmission rates have raised health concerns globally. Hence rather than saying this variant 'mild,' it should be considered a "very high" risk variant in the coming days to draw the serious attention of entire healthcare systems through the proper preparedness of respective governments [9].

Table 1: Top 10 countries' COVID-19 death status (per 1 lakh population as on 24th Jan 2022) [10].

Country	Deaths (in Lakh)	Death Rate	Total Cases (million)
US	8.6	263	70
Brazil	6.2	295	24
India	4.9	036	39
Russia	3.2	223	11
Mexico	3.0	238	05
Peru	2.0	629	03
UK	1.5	230	16
Indonesia	1.4	053	04
Italy	1.4	238	10
Colombia	1.3	263	06

Source: https://www.bbc.com/news/

Materials and Methods

This research study included 62 patients as our samples detected covid positive with either delta or omicron variant. The subjects were considered in gross from April 2021 till 15th January 2022. They were in between 30-50 years, stayed at home isolated, and not severely ill, which was the most important inclusion criteria. The comorbidities such as type 2 diabetes, obesity class 1 and 2, hepatomegaly grade 1 and 2, dyslipidemia were the associated health issues among these covid infected patients. We conducted telephonic interviews with each patient based on the predefined relevant questions almost on the ending days of home isolation. Every patient provided their email consent about unconditional participation in the study also. So, six questions were asked to everyone for 15 minutes maximum. However, 50 patients were offered free online diet consultation due to fatigue and other changes of biochemical test reports after the home-isolation period. Before diet consultation, they also self-tested serological allergy tests (SAT) through the ELIZA method. Some allergic conditions were observed among those patients, such as skin rashes, allergic rhinitis, hypoxia/hypoxemia, and food intolerance. Food is mostly from citrus fruits, milk, mustard oil, and vegetable cum fruits. We, therefore, selected ten ingested allergens as per allergic foods for our study.

Results

Serological allergy test (SAT) shows more accurate results for

allergic patients than other tests. In the study, specific IgE (IU/ml) from <0.22 to >10.0 range was taken as IgE level irrespective of antibodies was 0-4. The interpretation of allergic status was either absent or present. In case present then very low ((+) to very high (++++). Absent or non-detectable protein ref. Unit/ml denoted as '0' was very low <0.35 and very high 17.00. All measurements were based on luminometer and densitometer. The table.2 shows the relationship and interpretation irrespective of specific IgE and antibody.

Table 2: Correlation with corresponding grades of antibody to assess the allergic status [11].

Specific IgE (IU/ml)	Antibody Class	Interpretation of allergic status	Protein Ref. Unit /ml	Luminometer Unit	Densitometer Net Volts
<0.22	0	Absent or Non-detectable (-ve)	0	0	0
0.22-0.70	1/0	Very Low or Equivocal (+)	<0.35	>11	>0.06
0.70-2.5	1	Low (+)	0.35-0.70	>26	>0.18
2.5-5.0	2	Moderate (++)	0.70-3.5	>65	>0.67
5.0-10.0	3	High (+++)	3.5-17.00	>142	>1.90
>10.0	4	Very High (++++)	17.00<	>242	>3.50

Table 3 shows the ten potential allergens that affected the patients who suffered from both the mentioned variants during the research period. Table 3 is also linked with table.2 in terms of interpretation. Moreover, the 50 subjects and their percentage have also been shown graphically in figure 1.

Table 3: Top 10 allergens detected in the patients suffering from delta and omicron variants with interpretation.

Sl. No	Name of Ingestant (Allergens)	Local Name	Specific. IgE (IU/ml.)	Interpretation	Frequency=Number of positivity (n=50)	Percentage
1	*Phaseolus sublobatus*	Moong dal	0.350-0.710	(+)	3	6%
2	*Egg products*	Egg	0.700-3.5	(++)	5	10%
3	*Hibiscus esculentus*	Ladies finger	0.355-0.700	(+)	3	6%
4	*Solanum melongena*	Brinjal	0.340-0.700	(+)	5	10%
5	*Musa paradisiaca*	Banana	0.335-0.700	(+)	7	14%
6	*Allium cepa*	Onion	0.330-0.700	(+)	5	10%
7	*Brassica nigra*	Mustard oil	0.320-0.700	(+)	12	24%
8	*Oryza sativa*	Rice	0.700-10.0	(++)	8	16%
9	*Citrus fruits*	Fruits	3.6-15.1	(+++)	14	28%
10	*Lactose*	Milk	3.7-16.2	(+++)	23	46%

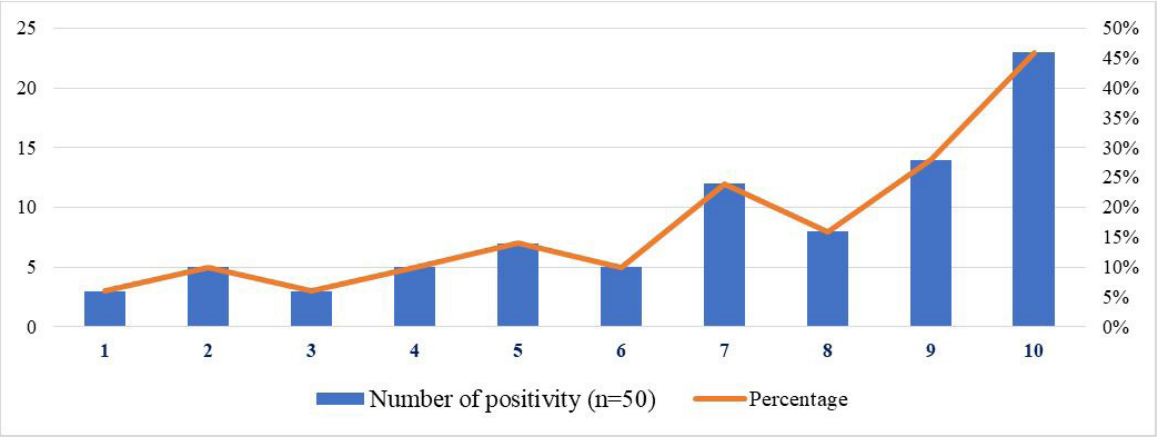

Figure 1: Number of positive samples irrespective of total allergic subjects with the analysis of the percentage

Discussion

This study considered ten foods commonly consumed at almost every Indian's house, whether vegetarian or non-vegetarian. Pulses, vegetables, fruits, fish, edible oil, milk, etc., contain particular allergens. The selected foods are often found with common complaints as allergens by many children and adults [11]. Our study is to understand the mechanisms of various allergens' activities towards the antibodies. Moreover, to see the links between some common food allergens affected the patients suffering from covid variants associated with comorbidities like DM-II, obesity, dyslipidemia, and hepatomegaly. Food allergies affect antioxidation activities and the total immunity in the patient's body. As a result, lack of oxygen was denoted as hypoxia or hypoxemia. Based on this short case study, we can interpret that food allergies can accelerate the respiratory syndromes that affect covid patients, mainly delta-infected cases. However, more case reports, case studies, and patients in hospital settings are required to cross-check the severity of lungs and cardiovascular systems. In figure1, we also found 23 samples of milk (46%), 14 (28%) samples of citrus fruits like sweet lemon, gooseberry, or other berries, 12 (24%) patients were allergic due to mustard oil based on the interpretation (+) of specific IgE (IU/ml). We found that 74% of infected and allergic patients during covid 2nd wave (delta variant) and 3rd wave (omicron variant) were also diagnosed with bronchial asthma, low oxygen levels, and other temporary health issues. The study did not segregate wave-wise infections and subsequent detections of allergy but considered only gross serological allergy tests (SAT) of total participants within the mentioned study frame. Here is a brief analysis of typical ingesting (allergens) as our study discusses food allergy interactions with immunoglobulin.

Various food allergy interactions with immunoglobulin:

The most commonly known allergic foods are wheat, wheat flour, rice, milk, brinjal, mustard seed and marine creatures like crab, prawn, and egg.

Wheat: *Triticum aestivum* is the most widely grown crop worldwide. Grain can result in specific immune responses characterized by Ig E & non-Ig E mediated. IgE-mediated food allergies are urticaria, anaphylaxis, and respiratory allergies such as Baker's asthma, Baker's rhinitis. Non-Ig E mediated mainly eosinophilic esophagitis or eosinophilic gastritis. Other wheat allergen names are alpha purothionin, thioredoxin, alpha-amylase, lipid-protein transfer, peroxidase, thiol reductase, thaumatin-like protein (TLP), serine proteases like inhibitor and gliadin [12].

Rice: *Oryza sativa* is a starchy cereal grain. It is most commonly used by one-half of the world population as a staple food. The ideal rice-based diet should be composed of l - cysteine, corn starch, maltodextrin, sucrose, corn oil, cellulose, mineral and vitamin mix, antioxidant, Tert- butyl hydroquinone (TBHQ) has anti-lipid peroxidation activity. Dietary rice bran acts as prebiotics, helps in lactobacillus colonization, and is also effective in the mucosal immune system to induce Ig A and enhance the innate immune response [13].

Egg Plant: *Solanum meldingen L.* is the king of vegetables and poor man's meat. In eggplant, allergens were analyzed for glycoprotein, which stimulates IgE. Mainly Eggplant peel contains nine allergens; the pulp contains three allergens. Protein analysis and IgE immunoblotting assessed the presence of glycans, and their stability in the simulated gastric fluid was evaluated by protein analysis and IgE immunoblotting [14].

Prawn: *Dendrobranchiata* has 540 extant species in seven families. Tropomyosin is the most frequent allergenic protein found in edible crustaceans and mollusks. This allergen is a dimeric alpha-helical coiled-coil protein that binds to actin throughout its length and governs troponin and myosin interaction, controlling muscle fiber contractions: Sarcoplasmic calcium-binding protein and arginine kinase [15].

Crab: *Scylla serrata* crabs are good for diabetes rich in chromium, which helps insulin metabolize sugar and lower blood glucose levels. Sialia acid-specific lectin place isolated from the serum of the freshwater crab *Paratelphuse jacquemontii* served as an antigen from immunoglobulin production. Anti-lectin IgG produced invertebrates [15].

Milk: Immunological activity found in milk and colostrum. They are central to the Ig link when the mother transfers passive immunity to the offspring. Bovine immunoglobulin in milk products has some effective mechanisms; it binds human pathogens & allergens, binds Fe receptor, and enhances phagocytosis supports gastrointestinal barriers functions in vitro. Casein and whey milk protein trigger the production of IgE. It causes anaphylaxis, shock, itching, facial flushing. Food protein-induced enterocolitis syndrome (FPIES) is often seen in lactose intolerance [16].

Mustard seed: *Brassica* juice derivatives of the mustard constituent allyl isothiocyanate form the basis for the toxic agents. Mustard is one of the most common spices allergies. The enzymes inside the mustard don't break down much in the digestive tract, and the allergen is present even if the mustard is cooked in food. The major allergen in brown mustard is Bra J 1 [17].

Egg: In avian blood (IgY), the main immunoglobulin is transmitted to their offspring and deposited in egg yolks, activating the non-invasive harvesting of the high level of antibodies. There was a reduced level of the eosinophils in the blood and the nasal areas where bronchial washout was found. There is also a reduced level of lymphocytes (agranulocytes), eosinophils, neutrophils (granulocytes) infiltration into the lungs, and the nasal mucosa of animals that were treated with anti-IL beta 1and anti-TNF ALPHA Ig Y alone or jointly [18].

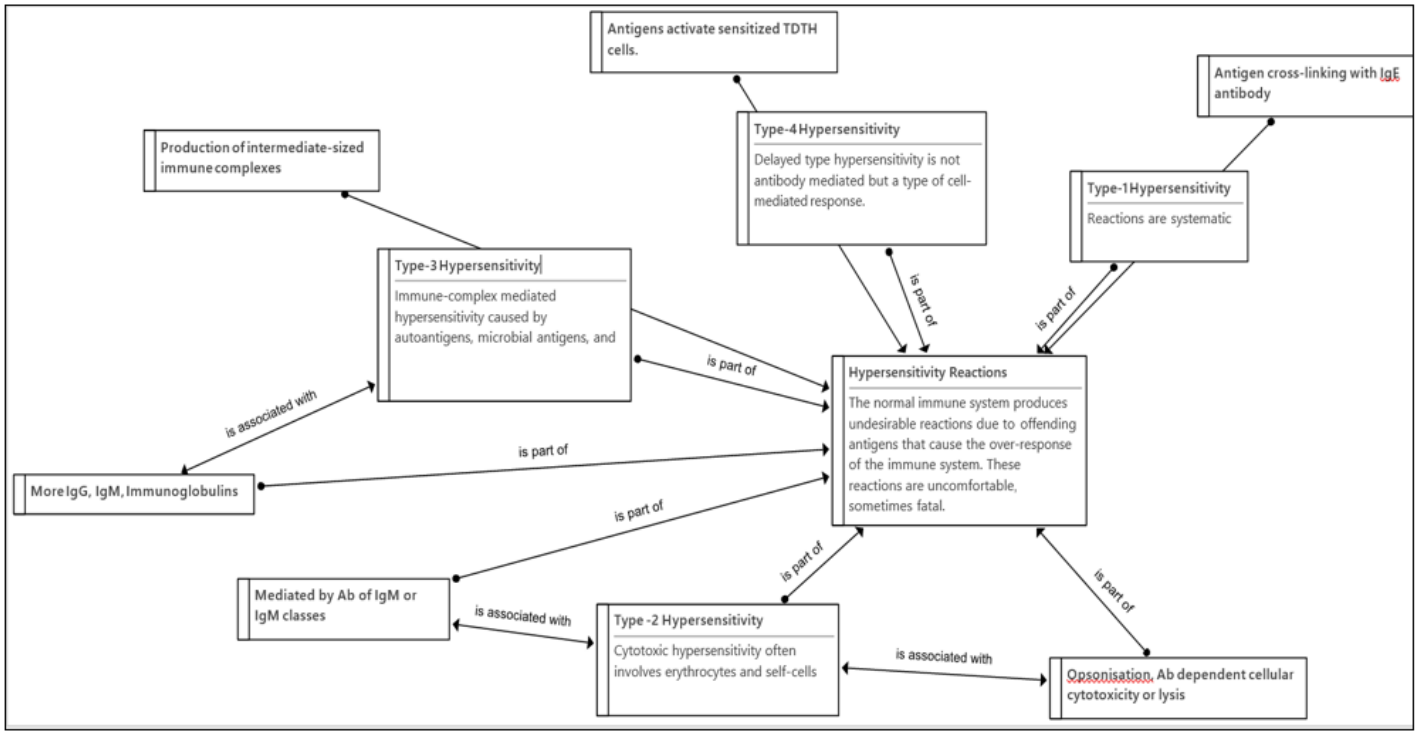

Figure 2: Four types of hypersensitivity reactions caused by the allergens among the patients

In the study, hypersensitivity caused due to food allergy was a significant concern. Hence, in the above figure 2, we showed the four types of hypersensitivity with different characteristics and modes of action. Type -1 hypersensitivity was common among allergic patients. The symptoms were allergic rhinitis, allergic bronchial asthma, food, drug allergy, etc. [19, 20].

Vaccines: As per the WHO technical report, the public health officials should take steps to boost COVID-19 vaccination coverage in all eligible populations, focusing on people at risk of the severe disease who are still unvaccinated or whose vaccinations are incomplete. These populations include the elderly, healthcare workers, and persons with underlying illnesses that put them at risk of severe disease and death [21].

Dietary advice: The participants (50) who were detected food allergies, either single or multiple allergens, were advised online essential diet. The dietary advice was high protein, minerals, and multivitamins rich, considering the proper inclusions of carbohydrate and fat percentage in the diet for diabetes and cardiac patient. So that they can come out from fatigue and other acute immunity disorders. Most importantly, the ten foods found allergic were removed from the diet with written advice for at least a year. In between, they were advised to send weekly or monthly feedback about the progress of comorbidities and allergies [22].

Conclusions

Food allergies can accelerate atopic conditions respiratory syndromes and reduce covid patients' oxygen level, mainly delta variant infections. There is a high chance of complications, as discussed among the food allergic patients who get infected by any variant of SARS-CoV-2. In addition to vaccines and proper lifestyles, the rightly prepared diet plan has a significant role mainly during recovery phases.

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