Immunity is the capability of multicellular organisms to resist harmful microorganisms. A large number of Indians have a lower intake of vitamins and other micronutrients which are needed. For example, our intake of Zinc, Vitamin C and D is generally lower than what is required for optimal immune function. Improving the nutritional status by including immunity boosting foods proves to be an essential factor in strengthening the immune system as well as managing the chronic conditions prevalent in the population.

**Objective:** To understand the importance of immunity boosting foods and its beneficial effects on the biochemical parameters and to evaluate the dietary consumption of the participants.

**Methodology:** A cross sectional study was conducted on the selected participants who were the residents of Mumbai. The study included two groups i.e., control and experimental. Both the groups were administered the pre intervention questionnaire after which only experimental group was counselled and after a period of three months again both the groups were administered the post intervention questionnaire. The data was analysed by using the Statistical Set of Social Software programme for Windows (SPSS, version 20). The analysis of data involved t-tests and Chi-Square tests. p value less than 0.05 was considered statistically significant.

**Results:** The comparison between control and experimental group showed significant differences as the total energy intake, protein intake, zinc intake, Vit A and C intake was higher and fats and carbohydrate intake was lower in the experimental group as compared to the control group post the intervention ($p<0.05$). The significant changes observed in the consumption of healthy and beneficial food items was increased in the experimental group post the intervention ($p<0.05$). There were positive changes observed in the experimental group as their mean fasting blood sugar levels, blood pressure. LDL cholesterol was decreased and HDL cholesterol was increased whereas in the control group mean fasting blood sugar levels, blood pressure, LDL cholesterol was increased and HDL cholesterol was decreased ($p<0.05$).

**Conclusion:** In the study it was found that the nutrition counselling had an positive impact on the increased consumption of immunity boosting foods which inturn had an positive impact on the biochemical parameters and the dietary intake.

**Keywords:** Immunity, immunity boosting foods, chronic diseases, healthy eating, COVID-19
Daily ginger consumption is found to be most strongly associated with a lower risk of hypertension and coronary heart disease. Spices consumption reduces CVD risk, reduces hypertension, manages the blood sugar levels. Spices and condiments consumption of black pepper improves the lipid profile, including the levels of total cholesterol, LDL and triglycerides (Pi-fen, et al. 2018). Green leafy vegetables have shown positive relation in association with management of chronic diseases, it helps in proper blood circulation and maintains the blood pressure in the normal range. An array of fruits, vegetables, oily fish, olive oil, nuts, legumes are all considered functional foods based on their natural contents of nutraceuticals, including polyphenols, terpenoids, flavonoids, alkaloids, sterols, pigments, and unsaturated fatty acids. Polyphenol-rich herbs, especially coffee, differently fermented teas have also shown to have various effectiveness on metabolic and microvascular activities, cholesterol and fasting glucose lowering, anti-inflammation and anti-oxidation in high-risk population (Ahmed alkhatab, et al. 2020). Consumption of milk and milk products provides probiotics which have been proven to maintain gut microbial and reduce the pathogenic activities thereby strengthen the immune system. (Tololupe joshua, 2020). It is found that there is a strong association between the consumption of certain pro biotics and the prevention, delay, or treatment of chronic diseases such as cardiovascular disease. (Charis M Galanakis, et al. 2020) [3].

**Results and Discussion**

**Table 1: General information**

| Categories              | Options       | Percentage (%) |
|-------------------------|---------------|----------------|
| Age                     | 40-50 years   | 10             |
|                         | 50-60 years   | 42             |
|                         | 60-70 years   | 32             |
|                         | 70-80 years   | 16             |
| Gender                  | Male          | 46             |
|                         | Female        | 54             |
| Educational Qualification | Completed secondary school | 45         |
|                         | Completed junior college | 10         |
|                         | Illiterate    | 4              |
|                         | Completed post-graduation | 10         |
| Chronic Conditions Found | Diabetes      | 31             |
|                         | Hypertension  | 30             |
|                         | Cardiovascular diseases | 6          |
|                         | Kidney disorder | 3           |
|                         | Lung disorder | 2              |

*Table no -1 shows out of the total 100 participants 42% of the participants both male and female were in the age group of 50-60 years followed by 32% in the age group of 60-70 years, 16% in 70-80 years and 10% in 40-50 years. The majority of the participants were from the age group between 50-60 years, 46% were males and 54% were females. Female participants were more as compared to the male participants. Most of the participants were secondary school passed out (45%) or have completed junior college (10%), few were illiterate (4%) other than these 30% were graduates and 10% were post graduates. Out of 100 participants, 31% were diabetic, 30% were suffering from hypertension, 6% were suffering from cardiovascular diseases; 3% were having kidney disorders and 2% were having lung diseases.*

**Material and Methods**

A cross-sectional study with the sample size of 100 participants was conducted in Mumbai. The 100 participants were equally divided into two groups i.e., controlled group and the experimental group. The participants were selected purely through their own willingness to participate. The participants were informed about the study, it’s purpose and its design. The required consents were taken before the data collection. Pre and post intervention method was used to collect the data from the selected participants. The questionnaire included the following aspects such as General information, educational qualification, medical history, Medications used, Biochemical parameters, Nutritional supplements, Eating habits, Food frequency questionnaire. 3 days 24-hour dietary recall. Online nutritional counselling sessions were conducted for the experimental group within the study period. The counseling was aimed to encourage the group to eat more of healthy foods, to consume meals on preferred ideal timing, to incorporate immunity boosting foods in the daily diet, to consume more protein rich food items.

**Statistical analysis**

The data was analyzed by using the Statistical Set of Social Software programmed for Windows (SPSS, version 20). The analysis of data included t-tests and Chi-Square tests. p value less than 0.05 was considered statistically significant.

**Table 2: Immunity boosting foods consumption in the control group**

| Food items  | Options       | Pre-intervention | Post-intervention | Chi-square | P-value |
|-------------|---------------|------------------|-------------------|------------|---------|
| Citrus fruits | Daily         | 22%              | 20%               |            |         |
|             | Once/week     | 26%              | 24%               |            |         |
|             | 2-3 times/week| 24%              | 20%               |            |         |
|             | Once/month    | 8%               | 5%                |            |         |
|             | 2-times/month | 18%              | 15%               |            |         |
|             | Never         | 2%               | 6%                |            |         |
| Guava       | Daily         | 6%               | 7%                |            |         |

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| Food items          | Options | Pre-intervention | Post-intervention | Chi-square | P-value |
|---------------------|---------|------------------|-------------------|------------|---------|
| Kiwi                | Daily   | 6%               | 4%                | 200.000    | 0.004   |
|                     | Once/week | 50%             | 47%               |            |         |
|                     | 2-3 times/week | 18%             | 17%               |            |         |
|                     | Once/month | 16%             | 13%               |            |         |
|                     | 2-3 times/month | 10%             | 7%                |            |         |
|                     | Never    | -                | -                 |            |         |
| Apple               | Daily   | 16%              | 14%               | 250.000    | 0.000   |
|                     | Once/week | 26%             | 24%               |            |         |
|                     | 2-3 times/week | 18%             | 19%               |            |         |
|                     | Once/month | 20%             | 22%               |            |         |
|                     | 2-3 times/month | 12%             | 15%               |            |         |
|                     | Never    | 8%               | 8%                |            |         |
| Flaxseeds           | Daily   | 32%              | 28%               | 250.000    | 0.004   |
|                     | Once/week | 12%             | 10%               |            |         |
|                     | 2-3 times/week | 14%             | 18%               |            |         |
|                     | Once/month | 12%             | 14%               |            |         |
|                     | 2-3 times/month | 10%             | 6%                |            |         |
| Sunflower seeds     | Daily   | 6%               | 4%                | 202.885    | 0.000   |
|                     | Once/week | 6%             | 4%                |            |         |
|                     | 2-3 times/week | 10%             | 8%                |            |         |
|                     | Once/month | 6%             | 8%                |            |         |
|                     | 2-3 times/month | 4%             | 6%                |            |         |
|                     | Never    | 68%              | 68%               |            |         |
| Black seeds (kalonji) | Daily      | 26%              | 21%               | 250.000    | 0.002   |
|                     | Once/week | 6%               | 4%                |            |         |
|                     | 2-3 times/week | 12%             | 11%               |            |         |
|                     | Once/month | 8%               | 11%               |            |         |
|                     | 2-3 times/month | 14%             | 18%               |            |         |
|                     | Never    | 34%              | 34%               |            |         |
| Walnuts             | Daily   | 18%              | 15%               | 250.000    | 0.000   |
|                     | Once/week | 30%             | 28%               |            |         |
|                     | 2-3 times/week | 18%             | 20%               |            |         |
|                     | Once/month | 14%             | 12%               |            |         |
|                     | 2-3 times/month | 10%             | 14%               |            |         |
|                     | Never    | 10%              | 10%               |            |         |
| Almonds             | Daily   | 30%              | 20%               | 250.000    | 0.048   |
|                     | Once/week | 20%             | 15%               |            |         |
|                     | 2-3 times/week | 20%             | 24%               |            |         |
|                     | Once/month | 14%             | 20%               |            |         |
|                     | 2-3 times/month | 6%             | 4%                |            |         |
|                     | Never    | 10%              | 10%               |            |         |
| Turmeric            | Daily   | 80%              | 78%               | 200.000    | 0.000   |
|                     | Once/week | 6%             | 8%                |            |         |
|                     | 2-3 times/week | 6%             | 4%                |            |         |
|                     | Once/month | 4%               | 1%                |            |         |
|                     | 2-3 times/month | 4%             | 3%                |            |         |
|                     | Never    | -                | -                 |            |         |
| Ginger              | Daily   | 80%              | 74%               | 250.000    | 0.000   |
|                     | Once/week | 8%             | 6%                |            |         |
|                     | 2-3 times/week | 2%             | 2%                |            |         |
| Food Items | Options         | Pre-intervention | Post-intervention | Chi-square | P-value |
|------------|----------------|------------------|-------------------|------------|---------|
|            | Daily          | 22%              | 42%               | 96.615     | 0.000   |
|            | Once/week      | 26%              | 34%               |            |         |
|            | 2-3 times/week | 24%              | 16%               |            |         |
|            | Once/month     | 8%               | 6%                |            |         |
|            | 2-times/month  | 18%              | 2%                |            |         |
| Citrus fruits | Daily          | 6%               | 28%               | 56.561     | 0.000   |
|            | Once/week      | 24%              | 40%               |            |         |
|            | 2-3 times/week | 32%              | 20%               |            |         |
|            | Once/month     | 8%               | 10%               |            |         |
|            | 2-times/month  | 22%              | 2%                |            |         |
|            | Never          | 8%               | 0%                |            |         |
| Guava      | Daily          | 0%               | 2%                | 81.092     | 0.000   |
|            | Once/week      | 10%              | 12%               |            |         |
|            | 2-3 times/week | 16%              | 14%               |            |         |
|            | Once/month     | 20%              | 54%               |            |         |
|            | 2-times/month  | 12%              | 12%               |            |         |
|            | Never          | 42%              | 6%                |            |         |
| Kiwi       | Daily          | 26%              | 30%               | 166.612    | 0.000   |
|            | Once/week      | 24%              | 30%               |            |         |
|            | 2-3 times/week | 22%              | 20%               |            |         |
|            | Once/month     | 8%               | 16%               |            |         |
|            | 2-times/month  | 16%              | 4%                |            |         |
|            | Never          | 4%               | 0%                |            |         |
| Apple      | Daily          | 6%               | 16%               | 72.857     | 0.000   |
|            | Once/week      | 50%              | 46%               |            |         |
|            | 2-3 times/week | 18%              | 26%               |            |         |
|            | Once/month     | 16%              | 10%               |            |         |
|            | 2-times/month  | 10%              | 2%                |            |         |
|            | Never          | -                | -                 |            |         |
| Spinach    | Daily          | 15%              | 16%               | 85.623     | 0.000   |
|            | Once/week      | 18%              | 26%               |            |         |
|            | 2-3 times/week | 9%               | 18%               |            |         |
|            | Once/month     | 20%              | 5%                |            |         |
|            | 2-times/month  | 12%              | 3%                |            |         |
|            | Never          | 8%               | 0%                |            |         |
| Carrots    | Daily          | 32%              | 38%               | 79.219     | 0.000   |
|            | Once/week      | 12%              | 20%               |            |         |
|            | 2-3 times/week | 14%              | 20%               |            |         |
|            | Once/month     | 12%              | 14%               |            |         |

Table 3: Immunity boosting foods consumption in the experimental group
In table no.3 and 4 was seen that, The experimental group observed an increase in the consumption of the pulses as compared to the control group as they were given nutritional counselling. Milk and Milk products were consumed more frequently in the experimental group as they were informed about the importance of pre biotic, pro biotic and protein content of the milk products, the consumption of milk and milk products was low in the control group as compared to the experimental group. As the nutritional counselling focused on the importance of consuming protein rich foods, the

| Food items          | Options          | Pre-intervention | Post-intervention | Chi-square | P-value |
|---------------------|------------------|------------------|-------------------|------------|---------|
| Turmeric            | Daily            | 80%              | 81%               | 114.465    | 0.000   |
|                     | 2-3 times/week   | 6%               | 7%                |            |         |
|                     | Once/month       | 4%               | 2%                |            |         |
|                     | 2-3 times/month  | 4%               | 0%                |            |         |
|                     | Never            | 0%               | 0%                |            |         |
| Ginger              | Daily            | 80%              | 82%               | 139.710    | 0.000   |
|                     | 2-3 times/week   | 8%               | 8%                |            |         |
|                     | Once/month       | 2%               | 0%                |            |         |
|                     | 2-3 times/month  | 4%               | 0%                |            |         |
|                     | Never            | 4%               | 4%                |            |         |
| Garlic              | Daily            | 72%              | 81%               | 166.667    | 0.000   |
|                     | 2-3 times/week   | 6%               | 3%                |            |         |
|                     | Once/month       | 2%               | 2%                |            |         |
|                     | 2-3 times/month  | 6%               | 7%                |            |         |
|                     | Never            | 4%               | 2%                |            |         |
| Black pepper        | Daily            | 66%              | 68%               | 117.232    | 0.000   |
|                     | 2-3 times/week   | 16%              | 18%               |            |         |
|                     | Once/month       | 6%               | 4%                |            |         |
|                     | 2-3 times/month  | 4%               | 2%                |            |         |
|                     | Never            | 8%               | 4%                |            |         |
| Cinnamon            | Daily            | 36%              | 56%               | 103.562    | 0.000   |
|                     | 2-3 times/week   | 28%              | 18%               |            |         |
|                     | Once/month       | 12%              | 12%               |            |         |
|                     | 2-3 times/month  | 4%               | 8%                |            |         |
|                     | Never            | 14%              | 4%                |            |         |
| Cloves              | Daily            | 44%              | 58%               | 115.258    | 0.000   |
|                     | 2-3 times/week   | 18%              | 12%               |            |         |
|                     | Once/month       | 12%              | 12%               |            |         |
|                     | 2-3 times/month  | 6%               | 2%                |            |         |

In table no.3 and 4 was seen that, The experimental group observed an increase in the consumption of the pulses as compared to the control group as they were given nutritional counselling. Milk and Milk products were consumed more frequently in the experimental group as they were informed about the importance of pre biotic, pro biotic and protein content of the milk products, the consumption of milk and milk products was low in the control group as compared to the experimental group. As the nutritional counselling focused on the importance of consuming protein rich foods, the
consumption of eggs, chicken was also increased in the experimental group post the counselling session. The consumption of eggs and chicken was decreased in the control group. There was an increase in the consumption of nuts and seeds in the experimental group as compared to the control group as they were given nutritional counselling and were encouraged to incorporate such food items in their daily diet.

The experimental group was made aware about the omega-3 and omega-6 content and its benefits. The experimental group was given counselling on importance of Vit A and Vit C on building a strong immune system as well as on managing the chronic diseases so the consumption of fruits rich in Vit A and Vit C was increased in the experimental group post the intervention as compared to the control group.

**Table 5: Changes in the biochemical parameters of the control group**

| Biological parameters | Control Group | t-value | P-value |
|-----------------------|---------------|---------|---------|
| Fasting blood sugar levels (mg/dl) | Pre-intervention N=50 | Post-intervention N=50 | | |
| Mean ± SD | 134.4±47.64 | 141.46±45.50 | -4.547 | 0.000 |
| Systolic blood pressure (mmHg) | Mean ± SD | 129.63±19.27 | 117.03±18.419 | 18.069 | 0.000 |
| Diastolic blood pressure (mmHg) | Mean ± SD | 84.11±4.872 | 79.63±4.216 | 11.7555 | 0.000 |
| Heart rate (beats/min) | Mean ± SD | 82.32±13.916 | 78.40±12.477 | 2.307 | 0.030 |
| Total cholesterol level (mg/dl) | Mean ± SD | 182.10±7.67 | 185.82±7.55 | -1.178 | 0.025 |
| HDL cholesterol levels (mg/dl) | Mean ± SD | 46.56±8.952 | 38.56±9.024 | 11.744 | 0.000 |
| LDL cholesterol levels (mg/dl) | Mean ± SD | 102.06±22.74 | 113.22±25.73 | -4.536 | 0.000 |
| Glomerular filtration rate (ml/min) | Mean ± SD | 76.25±10.62 | 76.50±11.09 | -1.000 | 0.391 |

**Table 6: Changes in the biochemical parameters of the experimental group**

| Biological parameters | Experimental Group | t-value | P-value |
|-----------------------|--------------------|---------|---------|
| Fasting blood sugar levels (mg/dl) | Pre-questionnaire N=50 | Post-questionnaire N=50 | | |
| Mean ± SD | 134.54±47.67 | 123.32±43.85 | 4.922 | 0.000 |
| Systolic blood pressure (mmHg) | Mean ± SD Median | 129.64±19.27 | 120.94±8.55 | 16.644 | 0.000 |
| Diastolic blood pressure (mmHg) | Mean ± SD Median | 84.89±12.12 | 80.42±9.92 | 24.920 | 0.000 |
| Heart rate (beats/min) | Mean ± SD | 82.32±13.91 | 79.28±12.95 | 1.901 | 0.069 |
| Total cholesterol level (mg/dl) | Mean ± SD | 185.8±7.57 | 166.29±80.94 | 0.257 | 0.000 |
| HDL cholesterol levels (mg/dl) | Mean ± SD | 46.38±8.78 | 52.94±12.34 | -3.681 | 0.002 |
| LDL cholesterol levels (mg/dl) | Mean ± SD | 114.72±23.77 | 101.22±23.09 | 5.764 | 0.000 |
| Glomerular filtration rate (ml/min) | Mean ± SD | 75±12.08 | 74.45±8.80 | 0.151 | 0.889 |

Table no 5 and 6 showed that, The biochemical parameters post the intervention showed changes like decrease in the fasting blood sugar level, decrease in the total cholesterol levels, decrease in the LDL cholesterol levels, systolic and diastolic blood pressure, increase in the HDL cholesterol levels in the experimental group. Whereas in the control group there was an increase in the fasting blood glucose levels, total cholesterol levels, LDL cholesterol levels, systolic and diastolic blood pressure and decrease in the HDL cholesterol levels.

**Conclusions**

In the study it was found that the nutrition counselling had an positive impact on the increased consumption of immunity boosting foods which inturn had an positive impact on the biochemical parameters. The improved biochemical parameters may have a beneficial effect on the management of chronic diseases. As the chronic diseases are the one which cannot be cured in a short span of time it is important to manage the parameters, complications associated with the chronic disease by changing the dietary patterns, inluding foods which are proven to manage the conditions as well as boosts immunity is one of the ways to manage the chronic diseases and live a healthy lifestyle.

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