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A comparative study on management of chronic diseases and consumption of immunity boosting foods in the COVID-19 pandemic

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Abstract
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 analysation 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 nutrtion counselling had an postive 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

Introduction
A large number of Indians have a lower intake of vitamins and other micronutrients than what is needed. Eating a low-fat, plant-based diet may help give the immune system a boost, fruits and vegetables provide nutrients like beta-carotene, vitamin C, and vitamin E which helps in boosting immune function as they are rich in antioxidants and also helps in reducing oxidative stress (James schend, 2020). Vit C rich foods also maintain the blood glucose levels, decreases the LDL cholesterol levels, lowers the risk of cardiovascular diseases (Jacob, *et al.* 2020). Consumption of green leafy vegetables and vit C rich foods have contributed in the reduction of developing CHD to less than 17% (Mellisa molser, *et al*. 2020). Zinc is a mineral that can help boost white blood cells, which defend against invaders. Sources include nuts, pumpkin seeds, sesame seeds, beans, and lentils. Spices like turmeric, pepper, ginger, garlic, cinnamon, are proven immunity boosters. Garlic also reduces the risks of cardiovascular disease by inhibiting platelet aggregation and lowering cholesterol and blood pressure (Yawen Zang *et al.*

2017). 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 alkhatib, *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].

Materials 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 analyzation of data involved t-tests and Chi-Square tests. p value less than 0.05 was considered statistically significant.

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 graduation	30
	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.

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%	250.000	0.000
	Once/week	26%	24%		
	2-3 times/week	24%	20%		
	Once/month	8%	5%		
	2-3times/month	18%	15%		
	Never	2%	6%		
Guava	Daily	6%	7%	250.000	0.000

	Once/week	24%	22%		
	2-3 times/week	32%	29%		
	Once/month	8%	10%		
	2-3times/month	22%	15%		
	Never	8%	21%		
Kiwi	Daily	10%	11%	200.000	0.000
	Once/week	16%	14%		
	2-3 times/week	20%	16%		
	Once/month	12%	10%		
	2-3times/month	42%	39%		
	Never	-	-		
Apple	Daily	26%	25%	250.000	0.000
	Once/week	24%	21%		
	2-3 times/week	22%	12%		
	Once/month	8%	18%		
	2-3times/month	16%	15%		
	Never	4%	4%		
Food items	Options	Pre-intervention	Post-intervention	Chi-square	P-value
Spinach	Daily	6%	4%	200.000	0.004
	Once/week	50%	47%		
	2-3 times/week	18%	17%		
	Once/month	16%	13%		
	2-3times/month	10%	7%		
	Never	-	-		
Carrots	Daily	16%	14%	250.000	0.000
	Once/week	26%	24%		
	2-3 times/week	18%	19%		
	Once/month	20%	22%		
	2-3times/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%		
	2-3times/month	10%	6%		
	Never	20%	20%		
Sunflower seeds	Daily	6%	4%	202.885	0.000
	Once/week	6%	4%		
	2-3 times/week	10%	8%		
	Once/month	6%	8%		
	2-3times/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%		
	2-3times/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%		
	2-3times/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%		
	2-3times/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%		
	2-3times/month	4%	3%		
	Never	-	-		
Ginger	Daily	80%	74%	250.000	0.000
	Once/week	8%	6%		
	2-3 times/week	2%	2%		

	Once/month	2%	2%		
	2-3times/month	4%	13%		
	Never	4%	8%		
Garlic	Daily	82%	78%	166.667	0.000
	Once/week	6%	5%		
	2-3 times/week	2%	1%		
	Once/month	-	-		
	2-3times/month	6%	4%		
	Never	4%	3%		
Black pepper	Daily	66%	69%	200.000	0.000
	Once/week	16%	15%		
	2-3 times/week	6%	4%		
	Once/month	-	-		
	2-3times/month	4%	2%		
	Never	8%	6%		
Cinnamon	Daily	36%	30%	250.000	0.000
	Once/week	28%	25%		
	2-3 times/week	12%	11%		
	Once/month	4%	6%		
	2-3times/month	6%	8%		
	Never	14%	14%		
Cloves	Daily	44%	40%	250.000	0.000
	Once/week	18%	15%		
	2-3 times/week	12%	14%		
	Once/month	8%	6%		
	2-3times/month	6%	6%		
	Never	12%	10%		

Table 3: Immunity boosting foods consumption in the experimental group

Food items	Options	Pre-intervention	Post-intervention	Chi-square	P-value
Citrus fruits	Daily	22%	42%	96.615	0.000
	Once/week	26%	34%		
	2-3 times/week	24%	16%		
	Once/month	8%	6%		
	2-3times/month	18%	2%		
Guava	Daily	6%	28%	56.561	0.000
	Once/week	24%	40%		
	2-3 times/week	32%	20%		
	Once/month	8%	10%		
	2-3times/month	22%	2%		
	Never	8%	0%		
Kiwi	Daily	0%	2%	81.092	0.000
	Once/week	10%	12%		
	2-3 times/week	16%	14%		
	Once/month	20%	54%		
	2-3times/month	12%	12%		
	Never	42%	6%		
Apple	Daily	26%	30%	166.612	0.000
	Once/week	24%	30%		
	2-3 times/week	22%	20%		
	Once/month	8%	16%		
	2-3times/month	16%	4%		
	Never	4%	0%		
Spinach	Daily	6%	16%	72.857	0.000
	Once/week	50%	46%		
	2-3 times/week	18%	26%		
	Once/month	16%	10%		
	2-3times/month	10%	2%		
	Never	-	-		
Carrots	Daily	15%	16%	85.623	0.000
	Once/week	18%	26%		
	2-3 times/week	9%	18%		
	Once/month	20%	5%		
	2-3times/month	12%	3%		
	Never	8%	0%		
Flaxseeds	Daily	32%	38%	79.219	0.000
	Once/week	12%	20%		
	2-3 times/week	14%	20%		
	Once/month	12%	14%		

	2-3times/month	10%	8%		
	Never	20%	0%		
Sunflower	Daily	6%	4%	184.758	0.000
	Once/week	16%	11%		
	2-3 times/week	16%	19%		
	Once/month	6%	14%		
	2-3times/month	4%	20%		
	Never	52%	32%		
Black seeds	Daily	26%	26%	110.409	0.000
	Once/week	6%	14%		
	2-3 times/week	12%	22%		
	Once/month	8%	16%		
	2-3times/month	14%	18%		
	Never	34%	4%		
Walnuts	Daily	18%	54%	90.145	0.000
	Once/week	30%	14%		
	2-3 times/week	18%	18%		
	Once/month	14%	10%		
	2-3times/month	10%	4%		
	Never	10%	0%		
Almonds	Daily	30%	54%	102.299	0.000
	Once/week	20%	20%		
	2-3 times/week	20%	12%		
	Once/month	14%	8%		
	2-3times/month	6%	6%		
	Never	10%	0%		
Food items	Options	Pre-intervention	Post-intervention	Chi-square	P-value
Turmeric	Daily	80%	81%	114.465	0.000
	Once/week	6%	6%		
	2-3 times/week	6%	7%		
	Once/month	4%	2%		
	2-3times/month	4%	0%		
	Never	0%	0%		
Ginger	Daily	80%	82%	139.710	0.000
	Once/week	8%	8%		
	2-3 times/week	2%	6%		
	Once/month	2%	0%		
	2-3times/month	4%	0%		
	Never	4%	4%		
Garlic	Daily	72%	81%	166.667	0.000
	Once/week	6%	3%		
	2-3 times/week	2%	2%		
	Once/month	0%	1%		
	2-3times/month	6%	7%		
	Never	4%	2%		
Black pepper	Daily	66%	68%	117.232	0.000
	Once/week	16%	18%		
	2-3 times/week	6%	4%		
	Once/month	0%	4%		
	2-3times/month	4%	2%		
	Never	8%	4%		
Cinnamon	Daily	36%	56%	103.562	0.000
	Once/week	28%	18%		
	2-3 times/week	12%	12%		
	Once/month	4%	8%		
	2-3times/month	6%	2%		
	Never	14%	4%		
Cloves	Daily	44%	58%	115.258	0.000
	Once/week	18%	12%		
	2-3 times/week	12%	12%		
	Once/month	8%	16%		
	2-3times/month	6%	2%		
	Never	12%	0%		

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 it's 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
		Pre-intervention N=50	Post-intervention N=50		
fasting blood sugar levels(mg/dl)	Mean ± SD	134±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±9.872	79.63±9.216	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	182.18±77	185.82±78.55	-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
		Pre-questionnaire N=50	Post-questionnaire N=50		
fasting blood sugar levels (mg/dl)	Mean ± SD	134.54±47.67	123.32±43.55	4.922	0.000
systolic blood pressure (mmHg)	Mean ± SD Median	129.63±19.27	120.92±9.85	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	184.18±67.79	166.29±80.94	5.752	0.000
HDL cholesterol levels (mg/dl)	Mean ± SD	48.83±8.78	52.94±12.34	-3.681	0.002
LDL cholesterol levels (mg/dl)	Mean ± SD	114.72±22.77	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 nutrtion counselling had an postive 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 cure 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 immuity is one of the ways to manage the chronic disseases and live a helthy lifestyle.

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