

## A nutritional study of covid-19 and its implications on comorbidities of diabetes mellitus and obesity in Agra

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**Abstract.** Whole world has come to a standstill during Covid-19 pandemic. Trend of work from home has started. Due to paucity of time and non-availability of seasonal fruits and vegetables, due to lack in supply chain system, focus is shifted from nutritious food to easy to made food items which in the long run are detrimental for the overall health of the body especially for those suffering from underlying health conditions and when medical aid is not available. Volunteer survey of around 50 people in 50-60yrs age group having co-morbidity of Diabetes Mellitus and obesity was conducted for 6 weeks in Agra district of U.P. A closed questionnaire was structured along with diet plan, nutritious easily available and stored food and is mailed to the participants of the study. Telephonic counselling was also conducted regarding their diet and physical activity. Blood sugars levels were monitored by self-monitoring system using Glucometer. It has been observed that 80% of the respondents with co-morbidities of Diabetes and obesity, were able to maintain their parameters in normal range during the lockdown period without visiting their doctors as they were not available, with the diet prescribed, their regular medication and physical activity.

### 1 Introduction

The novel corona virus has taken the world by storm. Alongside covid-19 Diabetes is a long-standing global Pandemic (1). Older people and people with pre-existing medical conditions such as Diabetes and other diseases appear to be more vulnerable to become severely ill with covid-19 virus. IDF (International Diabetes Federation) estimates that there are 463 million adults worldwide living with Diabetes (2).

Type 2 diabetes (formerly called non-insulin dependent, or adult onset) results from the body's ineffective use of insulin. The majority of people suffering with diabetes, have type-2 diabetes mellitus. This type of diabetes is largely the result of excess body weight and physical activity.

Obesity is a state of excess accumulation of fat in the body. In clinical terms, Obesity is a condition of excess body weight when a person is 20% or more above the ideal body weight. Obesity is a significant risk factor and contributor to increased morbidity and mortality, most importantly from diabetes and cardiovascular disease, but also from cancer and chronic diseases like including osteoporosis, liver, sleep apnea and depression (3). Obesity is a worldwide pandemic, with an estimated 57.8% of adults worldwide expected to be classified as obese by 2030 according to figures released by the World Health Organization (WHO) (4). Obesity is characterized by an excessive of body fat that give rise to significant comorbidities, such as Diabetes Mellitus, hypertension, dyslipidemia, cardiovascular disease and many cancers (5-7). Therefore, obesity invariably referred to as a crucial public health problem and requires urgent attention in order to prevent obesity and related health outcomes.

As country introduce measures to restrict movement as part of efforts to reduce the number of people infected with covid-19, people are making huge changes to their daily routines. People are bound to work from home, children are doing home schooling putting extra pressure on house wives. This has aggravated the problem of obesity further. This has several implications on food habits both individually and globally. In a recent market survey food consumption pattern was evaluated during the early period of covid-19 epidemic in Italy, showed a higher consumption of pasta, eggs, long life and frozen food items and a reduction in fresh fruits and vegetables when compared to same period in 2019 (8).

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A large (n=3533) Italian survey showed that 53.9% of the participants have changed their lifestyle during covid-19 lockdown period in 2/3<sup>rd</sup> higher consumption of junk foods and sweets and reduced intake of fruits and vegetables as compared to usual intake (9). A recent survey on patients with Type-2 Diabetes Mellitus during the lockdown period in India showed increase level of snacking, carbohydrate intake and weight gain which has the potential to destabilize glucose control (10). The WHO (World Health Organization) has announced dietary guidelines during the covid-19 outbreak stressing the importance of a balanced diet to maintain a strong immune system and to avoid or minimize chronic disease infections (11). It appears that while we are tackling anxiety due to pandemic and eagerly waiting for solutions, basics of Diet and lifestyle have been ignored. So, the present study was undertaken to magnify the effect of optimum nutrition and age-old yoga and Ayurveda especially in comorbidities of Diabetes Mellitus and obesity during current COVID-19 pandemic.

## 2 Methodology

A total of 50 individuals of Agra district, 25 men and 25 women with Type 2 Diabetes aged between 50-60yrs of age, not on insulin therapy, not taking any medicine for other health conditions except diabetes. All subjects are taking sulphonyl urea drugs and medication did not change during the study were selected. All subjects were in obesity grade -1 (BMI < 30) (12). After briefing them about the objective of the study a 3 days dietary recall was taken initially.

The different food items consumed were converted into their raw equivalents, categorized into their respective food groups and the average daily intake of protein, energy, fat and carbohydrate were calculated using the tables of nutritive value of Indian foods (13). Their background information regarding their occupation, medical history, dietary habits and intake was collected by telephonic interview cum questionnaire method. Subjects were asked to fill their basic anthropometric measurements, Body weight was measured by digital weighing scale and Height by their own ways as salters spring balance is not available to everyone. BMI was calculated by using the formula given by Garrow (14) i.e.,  $BMI = \frac{WT}{HT^2}$  (kilogram)/HT (in meter square) as shown in Table: 3 and their basic parameters like Blood Pressure (morning, evening) were taken on daily basis, Random Glucose levels were taken using Glucometer (self-Blood Glucose Monitoring).

A Diabetic Diet containing Low Glycemic Index foods (as shown in Table: 2), High protein and High Fiber diet (with inclusion of frozen peas, soybean chunks as COVID-19 has actually affected the supply chain) with special inclusion of Quinoa, oats and cinnamon is given to them. Special instructions were given about eating patterns (6 meal pattern) is given, with a list of food items to be included and restricted as shown in Table No: 1, along with list of low Glycemic index food items is mailed to them. Different food alternatives were also given to them which were low in calories too as shown in Table No: 4.

Regular use of Giloy (*Tinospora Cordifolia*), Ashwagandha (*Withania Somnifera*), Tulsi (*Ocimum tenuiflorum*) was also suggested (15) to boost up their immunity. Yoga, which originated in India more than 5000 years ago, aims at balancing and harmonizing the body, mind and emotions (16). Increasing evidence suggests that yoga practice tackles the pathophysiologic mechanisms of diabetes and its complications (17). Along with that it has role in controlling weight too. Although yoga has been practiced since ancient times, Yoga as a therapy is still relatively new and emerging trend in health care field. So here in this study 45 minutes of Yoga is suggested with links shared for various asanas (18) which includes shukshama yogic kriya followed by kapal Bharati (skull shining breathing technique), Supta-Matsyendrasana (Lying down body twist), Dhanurasana (Bow pose), Paschimottanasana (Seated forward bend), ArdhaMatsyendrasana (sitting half spinal twist), Shavasanas (corpse pose). (19) In a 2009 study, people who participated in a 12-week yoga course saw improvements in their weight, insulin levels, blood pressure, and triglycerides, all of which play a role in the emergence of type 2 diabetes and other aspects of metabolic syndrome (20). Regular follow up was done using mails and telephonic conversation and other media for six weeks.

**Table 1.** Food choices

<b>Foods not allowed</b>	<b>Foods restricted</b>	<b>Foods used freely</b>
Glucose	Potatoes	Green leafy vegetables
Sugar	Yam	Tomatoes
Honey	Arbi	Cucumber
All sweets	Sweet potatoes	Raddish
Chocolates	Mangoes	Lemon
Candies	Grapes	Clear soups
	Bananas	Black coffee
	Alcoholic beverages	Tea w/o sugar
	Fried foods	Buttermilk
	Paranthas	Sour chutneys
	Pooris	Pickles w/0 oil
	Pakorras	Quiona
	Dalmoth	Oats
	Mathris	
	Deep fried vegetables	
	Dry fruits	
	Salad oils	
	Cakes & pastries	

Source: Textbook of Nutrition & Dietetics by Kumud Khanna, page 198 (21)

**Table 2.** Glycemic index <60 of certain food items

<b>Food item</b>	<b>G. Index</b>
Peas	51
Rajmah	29
Lentils	29
Apples	39
Orange	40
Methi	34
Curd	36
Barley	31
Oats	49
Buckwheat	51
Corn	51
Quinoa	53

Source: Textbook of Nutrition and Dietetics by Kumud Khanna, page 302 (22)  
 \*glycemic index is a measure of how carbohydrate food affects our blood glucose levels

**Table 3.** Various grades of obesity

<b>Grade</b>	<b>BMI</b>
Underweight	<18.5
Normal range	<18.5-24.9
Overweight/preobese	>25
Grade I	30-34.9
Grade II	35-39.9
Grade III	>40.0

Source: Textbook of Nutrition and Dietetics by Kumud Khanna, page 189 (23)

**Table 4.** Healthy food alternatives suggested

<b>Items</b>	<b>Alternatives</b>
Paratha (200 calories)	Plain chapati (80 calories)
Pulao/fried rice (170 calories/75gm)	Plain boiled rice (80 calories/75 gm)
Fried vegetables (140 calories/100 gram)	Baked vegetables (50 calories/100gm)
Fried or curried chicken or fish preparation(250cal/135gm)	Grilled (tandoori) chicken/fish (160cal/135gm)
Fried eggs; omelet (120cal)	Poached/half boiled egg (60 calories)
Salad oil/mayonnaise dressing (100 cal/1 tbs/14 gm)	Lemon dressing (0 cal)
Sour cream (210 cal/100 gm)	Yoghurt (60 cal/100gm)
Regular sugar (20 cal/1tsp)	Caramelized sugar (5 cal/1tsp)
Regular pudding or dessert (average 150 cal/serving)	Fresh fruits as dessert (40 cal/piece)
Aerated soft drink (cal 60-80)	Plain soda with fresh lime (0 cal)
Whole milk (170 cal/glass)	Skimmed milk (80 cal/glass)
Sherbet (80 cal/glass)	Butter milk (40 cal/glass)

Source: A Diabetics Guide to Healthy Eating by Rekha Sharma (24)

### 3 Analysis

Results are analyzed using SPSS 25 version and descriptive statistics of all the parameters shows the following results.

**Table 5.** Descriptive statistics

	<b>N</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>	<b>Std. Deviation</b>
Age	50	50.00	60.00	54.9200	3.36755
Weight	50	76.00	90.00	81.9000	4.07206
BMI	50	30.00	35.00	32.2400	1.84678
Glucose	50	130.00	150.00	140.3400	5.84706
Weight after 6 weeks	50	72.30	86.60	78.7140	4.03323
BMI After	50	26.10	32.00	28.6320	1.95317
Glucose after 6 weeks	50	120.00	135.00	128.0000	5.07495
Valid N (list wise)	50				

**3.1 Hypothesis:**

- H1: There is a significant impact of the yoga and diet recommended on weight (reduced)
- H2: There is a significant impact of the yoga and diet recommended on BMI (reduced)
- H3: There is a significant impact of the yoga and diet recommended on Glucose levels (reduced)

Paired t test: Paired t test is used to check and validate the hypothesis and results are discussed in table 5-10

H1: There is a significant impact of the yoga and diet recommended on weight (reduced)

Paired t test is used to analyze the effect of the recommendations given over six weeks and gave the results given in table 5 & 6:

**Table 6.** Paired sample statistics-Weight

		MEAN	N	STD DEVIATION	
PAIR 1	WEIGHT	82.8800	50	4.77511	.67530
	WEIGHT(A)	79.6940	50	4.73047	.66899

**Table 7.** PAIRED SAMPLE STATISTICS

PAIRED DIFFERENCES									
		MEAN	STD. DEVIATION	STD.ERROR MEAN	95% CONFIDENCE INTERVAL OF THE DIFFERENCE		T	df	Sig
						Lower	Upper		
Pair 1	Weight Weight(a)	3.18600	.37363	.05284	3.07982	3.29218	60.297	49	.000

Result H1: Since the p value is 0.00 which is a strong evidence to validate our first research hypothesis and it concluded at 1% level of significance that there is significant drop in the weight after six weeks of diet and yoga recommended to the respondents.

H2: There is a significant impact of the yoga and diet recommended on BMI (reduced)  
Results of paired t test (table 7&8)

**Table 8.** BMI

PAIRED SAMPLE STATISTICS					
		MEAN	N	STD.DEVIATION	STD.ERROR MEAN
PAIR 1	BMI	32,5200	50	1.75243	.24783
	BMI (A)	28,9120	50	1.76654	.24983

**Table 9.** BMI

PAIRED SAMPLE TEST									
PAIRED DIFFERENCES									
		MEAN	STD. DEVIATION	STD. Error Mean	95% confidence Interval of the Dif-ference		T	Df	Sig(2-tailed)
						Lower	Upper		
PAIR 1	BMI BMI (A)	3.60800	.27168		1.53079	3.68521	93.905	49	<b>.000</b>

Since the p value is 0.00 which is a strong evidence to validate that there is a significant drop in the BMI after 6 weeks of diet and yoga recommended to the subjects.

Result H2: Since the p value is 0.00 which is a strong evidence to validate our first research hypothesis and it concluded at 1% level of significance that there is significant drop in the BMI after six weeks of diet and yoga recommended to the respondents.

H3: There is a significant impact of the yoga and diet recommended on Glucose levels (reduced)  
Results of paired t test are given in table 10&11

**Table 10.** Paired Samples Statistics-Glucose

Paired Samples Statistics-Glucose					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	R. Glucose	140.3400	50	5.84706	.82690
	R. Glucose After	128.0000	50	5.07495	.71771

**Table 11.** -Paired Samples Test-Glucose

Paired Samples Test-Glucose									
		Paired Differences					T	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	R. Glucose R. Glucose After	12.34000	6.65049	.94052	10.44995	14.23005	13.120	49	.000

Result H3: Since the p value is 0.00 which is a strong evidence to validate our first research hypothesis and it concluded at 1% level of significance that there is significant drop in the Glucose levels after six weeks of diet and yoga recommended to the respondents.

#### 4 Findings

It was seen that before counselling meal pattern that was followed was usually 3 meal patterns i.e., breakfast, lunch and dinner and sometimes just having deep fried food items in gaps in between. And especially during lockdown it was more of munching on fried food items, biscuits, namkeen, cakes n frozen food items with no fixed timings. The meal pattern of the subjects after the dietary modifications changed to 6 meal patterns with total cut down on fried and frozen food items and healthy easily available options were given to them. Eating habits improved during this 6-month time period. Initially due to restriction of movement the subjects were physically inactive. After counselling they were taught through videos about 45 minutes of yoga. The study has shown the efficacy of yoga and its effect on their flexibility.

The impact of dietary modification and yoga for 6 weeks has shown a drastic change in their weights as subjects lost 3.5 kgs on an average during this 6-week time period. The impact of weight was seen on BMI, the BMI levels shifted to pre-obese range from obesity grade-I. There is improvement in blood glucose levels as measured by Glucometer (self-blood glucose monitoring). There were more stable and much towards the normal range meant for diabetic patients. It was also noted that none of the subject fall ill during this entire course of study as herbs were introduced into the diet of the subjects According to Ayurveda, Giloy is an exceptional herb that builds immunity. It is rich in anti-oxidant that fight free radicals and keep cells healthy (25). Ayurveda being the science of life, propagates the gift of nature in maintaining healthy and happy living. Ayurveda is a bland based science. The simplicity of awareness about oneself and the harmony each individual can achieve by uplifting and maintaining his or her immunity is emphasized across Ayurveda’s classic scriptures. (26).

## 5 Implications

The dietary modifications and inclusion of herbs along with yoga resulted in overall improvement in the subjects having co-morbidities of Diabetes and obesity. This combination could be applied to other comorbidities too. This study will be helpful in self-management of Diabetes, which is a work in progress, which requires a shift in patient provider interaction beyond the walls of the clinics and hospitals. The need of the hour is innovative patient education programs as well as numerous ideas on how to improve meal plans (with inclusion of Ayurveda) and physical activity especially our age-old yoga.

This study prompts the fact that there is an urgent need of self-management of lifestyle diseases like diabetes, obesity especially in conditions when medical advice is not available for longer period of time. This study shows that this combination of optimum nutrition, Ayurveda and yoga could be applied to other comorbidities.

## 6 Limitations

Due to lockdown and restricted movement and lack of face-to-face interaction, it was difficult to monitor respondents accurately for longer periods of time, so restricted the duration to six weeks, which otherwise proved to have given more accurate results.

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