

# Synergistic effect of *Moringa oleifera* and *Allium sativum* on BMI and lipid profile: A randomized controlled trial

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**Abstract:** We investigate the synergistic effect of *Moringa oleifera* and *Allium sativum* on hyperlipidemic patients. It was a randomized controlled trial. The sample size of this study was 60 patients who were divided into four equal groups (n=15) through a random sampling technique. Pre assessment of all participants was conducted at the start of the research. The control group (group A) received atorvastatin 10mg QD as well as placebo capsules. The treatment group 1 (group B) received atorvastatin 10mg QD as well as *Moringa oleifera* 2g (capsule 1g BID). Treatment group 2 (group C) received atorvastatin 10mg QD as well as *Allium sativum* 2g (capsule 1g BID). Lastly, treatment group 3 (Group D) received atorvastatin 10mg QD as well as combined *Moringa oleifera* 2g (capsule 1g BID) and *Allium sativum* 2g (capsule 1g BID). After an intervention of 45 days, post assessment was conducted. The results showed total cholesterol and triglycerides and low-density lipoprotein of participants of treatment group 3 who received both MO and AS were statistically significant (p<0.05). The group that was on *Moringa oleifera* supplements alone was found to be statistically significant (p<0.05). This study concluded that *Moringa oleifera* and *Allium sativum* considerably improved the BMI and lipid profile of participants.

**Keywords:** *Moringa oleifera*, *Allium sativum*, cholesterol, triglyceride, LDL, HDL.

## INTRODUCTION

Cardiovascular disease is the prime source of death worldwide, with an estimated 17.9 million lives annually (Feinstein *et al.* 2019). Based on the current scenario of CVD, it can be expected to reach 24.8 million by 2030 (Estruch *et al.* 2013). Dyslipidemia, which includes elevated levels of total cholesterol (TC), low-density lipoproteins (LDL) and triglycerides (TG), as well as reduced levels of high-density lipoprotein (HDL), is one of the main causes of cardiovascular illnesses (Sun *et al.*, 2018). This is mainly due to diet and a sedentary lifestyle but can be an inherited disease in people with heterozygous family hypercholesterolemia (Shahid and Sarwar 2020). One research reported a 50% higher death rate in Bangladesh, Pakistan and India due to coronary disease as compared to other populations (Munawar *et al.*, 2019). In Pakistan, around 29.6% of the population was affected by CAD among 320 populations (Jafar *et al.*, 2005). In the hospital, lipid-lowering drugs are used for treating hyperlipidemia but there is a need to educate people regarding natural substances that have the potential to work with medicinal treatment for better results (Almukhtar *et al.*, 2020).

*Moringa* is a traditional plant from Africa and Asia that belongs to the Moringaceae family (Padayachee and Bajinath 2012). *Moringa oleifera* is the one that is cultivated mostly in sub-Himalayan regions of Pakistan,

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Bangladesh, India, and Afghanistan (Ajibade *et al.*, 2013). There are several studies based on the beneficial effects of *Moringa oleifera* in humans as well as in animals. These advantageous effects are because of the presence of bioactive molecules in *Moringa oleifera*, as it is rich in vitamins, plant phenolic compounds, flavonoids and carotenoids. Quercetin is the most important flavonoid that is found in *Moringa oleifera* leaves (Bischoff 2008). All parts of *Moringa oleifera* such as its roots, bark, gum, leaves, flowers and seeds have beneficial effects while dried leaves powder is a great source of polyphenol compounds, such as flavonoids and phenolic acids (Vergara-Jimenez *et al.*, 2017). *Moringa* possesses antihyperlipidemic effects on human as well as animals (Jain *et al.*, 2010, Sandoval and Jimeno 2013). *Moringa* is used as medicine against cancer, hypertension, hyperlipidemia, diabetes, cardiovascular diseases as well as obesity. Previously, multiple researches were conducted on cell lines of animals that concord with these medicinal properties (Leone *et al.*, 2015). This plant is potent enough to treat multiple diseases because it contains essential amino acids, and carotenoids in leaves (Abdull Razis, *et al.*, 2014).

*Allium sativum* is a plant species belonging to the onion family, commonly known as garlic. It has antioxidant effects. Garlic powder is also beneficial in the control of pathogens, especially bacteria and fungi. *Allium sativum* contains vitamins and minerals, linolenic acid and carbohydrates (Adeniji *et al.*, 2019). It has been used in

food preparation to enhance the flavors and used as herbal medicine since ancient times. *Allium sativum* has several effects such as antihypertensive, anti-hyperlipidemia, cardioprotective, antiplatelet, hypoglycemic and antimicrobial effects (Alam *et al.* 2018). Garlic has significant findings against serum cholesterol, LDL, while improving the levels of HDL (Kojuri *et al.*, 2007). Garlic and coriander seed powder significantly improve BMI and HDL while they reduce total cholesterol, triglycerides, LDL cholesterol and systolic blood pressure (Zeb *et al.*, 2018).

Various studies on *Moringa oleifera* and *Allium sativum* were carried out, which were conducted on human subjects individually. However, there is a lack of awareness of the synergistic effects of *Moringa oleifera* and *Allium sativum* on lipid profile and BMI of hyperlipidemic human individuals. Therefore, this study investigated the synergistic effects of *Moringa oleifera* and *Allium sativum* on the lipid profile of hyperlipidemic patients which was the novelty of this study.

## MATERIALS AND METHODS

### *Study area*

This study was performed in Ali Hospital Lahore, from November 2022 to February 2023.

### *Preparation of capsules*

*Moringa oleifera*, *Allium sativum* (Garlic), and placebo capsules were prepared from a local pharmacy in Lahore.

### *Sample size*

The sample size was calculated from the online calculator Raosoft. (Raosoft 2020) The study sample size was 60 participants (n=15).

### *Study groups*

Group A (Control group): This group received atorvastatin 10mg QD as well as placebo capsules STARCH.

Group B (Treatment group 1): This group received atorvastatin 10mg QD as well as *Moringa oleifera* 2g (capsule 1g BID).

Group C (Treatment group 2): This group received atorvastatin 10mg QD as well as *Allium sativum* 2g (capsule 1g BID).

Group D (Treatment group 3): This group received atorvastatin 10mg QD as well as combined *Moringa oleifera* 2g (capsule 1g BID) and *Allium sativum* 2g (capsule 1g BID).

### *Inclusion criteria*

- Both male and female participants
- The age group of 25-55 years
- Subjects clinically diagnosed with hyperlipidemia (cholesterol >200mg/dl, triglycerides >200 mg/dl, LDL >130mg/dl and HDL <50 mg/dl)

- Subjects able to understand simple instructions, independently

### *Exclusion criteria*

- Pregnant or lactating mothers
- History of any other ailment or infection
- History of any psychological disorder

### *Data collection tool*

#### *Anthropometrics*

Anthropometrics including height, and weight were taken. A standard weighing scale was used for determination of weight while height was measured by height measuring scale. Body mass index (BMI) was calculated using the standard formula (uddin Ismail, Ali *et al.* 2012).

$BMI (kg/m^2) = \text{weight (kg)} / \text{height (m}^2)$

#### *Lipid profile test*

For lipid profile, 12 hours of fasting is required. Blood samples were taken from total participants to evaluate serum cholesterol, triglycerides, HDL cholesterol and LDL cholesterol. The lipid profile was measured by enzymatic and colorimetric methods using DYTONA plus kit.

#### *Ethical approval*

The study was approved by Research and Ethics committee of Riphah International University, Lahore. (No. REC/RCR & AHS/22/0807)

## STATISTICAL ANALYSIS

The data were analyzed with SPSS software version 22. The results were analyzed by applying ANOVA and the Tukey test. Data were presented as mean±SD and p<0.05 was considered as level of significance.

## RESULTS

The study was designated to assess the synergistic effects of *Moringa oleifera* and *Allium sativum* on hyperlipidemia. Baseline information regarding the study participants and their lipid profiles was analyzed.

#### *Baseline characteristics of participants*

Gender distribution of participants showed that in the control group, female participants were 66.7% while male participants were 33.3%. In the treatment groups, *Moringa oleifera*, *Allium sativum* and both *Moringa* with *Allium sativum* group, female participants were 86.7%, 80% and 66.7% respectively while male participants were 13.3%, 20% and 33.3% respectively (fig. 1). Average body mass index (BMI) of participants ranged from 30.50 to 34.31 kg/m<sup>2</sup> whereas the average values of TC, TGL, HDL and LDL were from 203 to 238.9, 175.6 to 318, 33.1 to 40 and 135 to 151.8 mg/dl, respectively.

**Table 1:** Baseline characteristics of participants before treatment

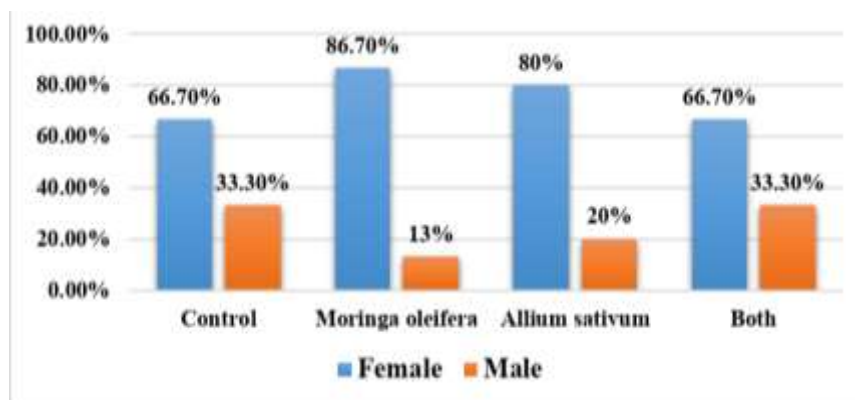
Parameter	Groups (n =60)			
	Control	MO	AS	MO-AS
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
BMI (kg/m <sup>2</sup> )	32.50 ± 8.86	34.31 ± 6.04	31.67 ± 5.62	30.50 ± 6.0
TC (mg/dl)	210 ± 38.2	221 ± 48.4	203 ± 46	238.9 ± 48.07
TGL (mg/dl)	260 ± 119.8	316 ± 138	175.6 ± 57	318 ± 184.5
HDL (mg/dl)	40 ± 22.4	35.7 ± 7.3	33.1 ± 7.5	37.6 ± 9.5
LDL (mg/dl)	138 ± 27.2	135 ± 60	151.8 ± 43.7	142.2 ± 47.2

BMI: Body Mass Index, TC: Total cholesterol, TGL: Triglycerides, HDL: High-Density Lipoprotein, LDL: Low-Density Lipoprotein, MO: *Moringa oleifera*, AS: *Allium sativum*, MO-AS: *Moringa oleifera* - *Allium sativum*

**Table 2:** Effect of *Moringa oleifera* and *Allium sativum* on BMI and lipid profile of hyperlipidemic patients

Biochemical parameter	Groups	Before treatment	After treatment
		Mean ± SD	Mean ± SD
BMI (kg/m <sup>2</sup> )	Control	32.50 ± 8.86	32.43 ± 8.82
	MO	34.31 ± 6.04	33.31 ± 6.12
	AS	31.67 ± 5.62	30.3 ± 5.72
	MO-AS	30.50 ± 6.0	29.34 ± 6.12
TC (mg/dl)	Control	210 ± 38.2	205.33 ± 36.64
	MO	221 ± 48.4	203.20 ± 44.69
	AS	203 ± 46	191 ± 43.5
	MO-AS	238.9 ± 48.07	219.73 ± 42.84
TGL (mg/dl)	Control	260 ± 119.8	252.93 ± 113.8
	MO	316 ± 138	274.07 ± 139.2
	AS	175.6 ± 57	162.40 ± 50.40
	MO-AS	318 ± 184.5	292.40 ± 177.4
HDL (mg/dl)	Control	40 ± 22.4	43.27 ± 22.08
	MO	35.7 ± 7.3	47.05 ± 6.92
	AS	33.1 ± 7.5	45.80 ± 7.54
	MO-AS	37.6 ± 9.5	50.67 ± 8.55
LDL (mg/dl)	Control	138 ± 27.2	133.20 ± 24.60
	MO	135 ± 60	127.80 ± 53.17
	AS	151.8 ± 43.7	136.87 ± 42.62
	MO-AS	142.2 ± 47.2	131.3 ± 44.02

\* post cholesterol p=0.04 < 0.05, post TG p=0.03 < 0.05, post HDL p=0.01 < 0.05, post LDL p=0.04 < 0.05



**Fig. 1:** Gender distribution of participants

### **Effect of *Moringa oleifera* and *Allium sativum* on BMI**

The BMI of participants was significantly reduced ( $p<0.05$ ) by treatment of both *Moringa oleifera* and *Allium Sativum* (table 2). In the control group, BMI was not significantly reduced whereas the highest reduction was observed in the AS treatment group from 31.67 to 30.3 kg/m<sup>2</sup>.

### **Effect of *Moringa oleifera* and *Allium sativum* on lipid profile**

The total cholesterol of participants was significantly decreased ( $p<0.05$ ) by treatment of *Moringa oleifera* and *Allium sativum* (table 2). The highest decline was observed in the MO-AS group from 238.9 to 219.73 mg/dl. Triglycerides of participants were significantly reduced ( $p<0.05$ ) by treatment of *Moringa oleifera* and *Allium sativum* (table 2). The highest reduction was noted in the MO-AS treatment group from 318 to 294.40 mg/dl. High-density lipoprotein improved significantly ( $p<0.05$ ). The highest increase was observed in the MO-AS treatment group from 37.6 to 50.67mg/dl. Low-density lipoprotein of participants was reduced significantly ( $p<0.05$ ). The highest decrease was achieved in the *Allium sativum* treatment group from 151.8 to 136.87 mg/dl.

## **DISCUSSION**

The current study demonstrated positive effects of *Moringa oleifera* and *Allium sativum* without exerting any side effects on human subjects. For this purpose, consumption of 2g each of *Moringa oleifera* and *Allium sativum* powder and their mixture administered to four different groups for a period of 45 days. In our case, both MO and AS significantly reduced total cholesterol, triglycerides and LDL while increased HDL. Previous studies have shown that a high serum concentration of total cholesterol, LDL and triglyceride together with reduced HDL ultimately increased the chances of coronary heart disease (Parab and Mengi 2002).

A similar study was conducted to evaluate the action of *Moringa oleifera* on hyperlipidemia, blood pressure and BMI in normal human subjects. In their study, the treatment group was given 0.03g/kg while group 2 was given 0.07g/kg body weight of *Moringa oleifera* (powdered) for 15 days. They concluded that *Moringa oleifera* does not have a significant effect on lipid profile and BMI at the end of the 14 days (Seriki *et al.*, 2015). Results of the current study in which 2g each of *Moringa* and *Allium sativum* both administered for a period of 45 days, significantly reduced the BMI of hyperlipidemic individuals in comparison with control and other treatment groups. The reduction of BMI of hyperlipidemic participants may be due to sulfur-containing compounds of garlic as they can reduce the production of fatty substances. In addition, moringa

leaves powder is a rich source of dietary fiber (0.90 g/kg) that ultimately helps in reduction of the body weight (Prabu *et al.*, 2019).

Results of the current study are consistent among the control and treatment groups, MO and AS combined group reduced total cholesterol as compared to other study groups as they reduced total cholesterol to 19.2 mg/dl. Combined MO and AS group also significantly improved HDL as compared to other groups as they increased HDL from a mean 37.6 mg/dl to 50.67 mg/dl. The results of the current study are in line with a previous study that was conducted to evaluate the synergic effects of black seeds and garlic powder with simvastatin. This previous study revealed that patients who received lipid-lowering medicine along with black seed and garlic for a period of 8 weeks showed significant findings (AH 2014).

In this study, *Allium sativum* powder alone showed the highest efficacy against LDL (151.8mg/dl to 136.87 mg/dl). The results of our present study were consistent with a previous study in which the garlic treatment group showed a significant reduction in total cholesterol, LDL cholesterol after interventions. While the placebo group had no significant differences (Ashraf *et al.*, 2005). The levels of triglycerides of the participants were also significantly influenced by the supplements. The highest effect impact was examined in *Moringa oleifera* group alone. Its effect was found more effective in reducing the triglyceride level of subject individuals (316mg/dl to 274.07mg/dl). Previous literature and studies support the findings of the current study that *Moringa oleifera* and *Allium sativum* powder significantly improved the lipid profile of participants. As discussed previously there is no study that evaluated the synergetic effects of these two functional foods. The present study presents the highest improvement in the lipid profile of participants who were examined in the treatment group (MO-AS both).

## **CONCLUSION**

Medical condition which is distinguish by upraised amount of serum cholesterol, triglycerides, LDL and reduced levels of HDL, known as Hyperlipidemia. Raised low-density lipoprotein cholesterol (LDL) is considered to be the foremost index of atherosclerosis, stroke and other cardiovascular diseases risk. The upward trend of CVD in Pakistan emphasizes the significance of managing dyslipidemia. Based on the literature and current study results, *Moringa* powder has significant effects on improving HDL and reducing BMI. While garlic powder caused a statistically notable lessen in BMI and LDL, however, a significant increase in HDL was noted. A mixture of *Moringa oleifera* and *Allium sativum* significantly lessened the amount of serum cholesterol, triglycerides and LDL cholesterol while raising HDL cholesterol.

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