

# Effect of Salat on Blood Sugar, Lipid Profile and Cognitive Improvement in Healthy Adults\*

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\*Part of the study was presented at Alzheimer's Association International Conference (AAIC-2012)- Vancouver, Canada.

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## Abstract

Salat is a mindful physical activity practiced all over the world at prescribed five times a day from dawn to dusk. Salat is also called Namaz, in Indian sub-continent. It takes only a few minutes for every session of salat to perform. Salat has been shown to have several health benefits if practiced over longer periods of time. In this study, we examined the effect of 12 months of Salat practice on blood sugar and lipid profile and on cognitive protection in healthy men over 50 years.

**Methods:** After written consent of the patients and approval of the institution's ethical committee, 100 men, age group 55 to 60 years were divided into two groups: Salat practice group (SG. N=50) and control group or (NSG. N=50). Subjects in the salat practice group were subjected to regular Salat practice for 12 months, while the control group did not participate in any salat activity or any other form of mindful physical activity (mostly sedentary professions with little physical activity). Fasting plasma glucose, post-prandial blood sugar, total cholesterol, triglycerides, low density lipoprotein, very low density lipoprotein and high density lipoprotein was examined before and after 12 months of salat intervention in both groups. Mini-cog test for cognitive evaluation was administered before and after the study.

**Results:** Salat group showed a significant ( $p \leq 0.05$ ) decrease in fasting plasma glucose, post-prandial blood sugar, total cholesterol, triglycerides, low density lipoprotein and very low density lipoprotein. Significant ( $p \leq 0.05$ ) increase in high density lipoprotein level was found in the salat group. NSG or control group showed insignificant changes in biochemical parameters and a lower mini-cog score compared to the SG group.

**Conclusions:** Long term practice of Salat, a mindful moderate regular physical activity, may prevent cardiovascular disease by reducing hyperlipidemia and prevent diabetes by improving glycemic control and provide cognitive protection

through the mindful meditative activity that may help prevent neuronal death, which in turn prevents cognitive decline and Alzheimer's in later stages of life.

**Keywords:** Salat, lipid profile, mini-cog, cognitive protection, blood sugar

## I. INTRODUCTION

In the past several years there has been a steady increase in the rate non-communicable diseases such as diabetes, cardiovascular diseases<sup>[1]</sup> and dementia<sup>[2]</sup>. India is home to an estimated 50 million people with diabetes in 2010 and by 2030, it will touch 87 million<sup>[1]</sup>. Death due to diabetes has made India Diabetic Capital of the World<sup>[3]</sup>.

Type 2 diabetes mellitus is a global health problem and one of the leading causes of mortality<sup>[4]</sup>. Dyslipidemia is the major risk factor for coronary artery disease in diabetes mellitus patients<sup>[5]</sup>. High plasma triglyceride concentration, low high-density lipoprotein (HDL) increased concentration of small dense low-density lipoprotein (LDL) particles are the hall mark of Diabetic dyslipidemia. Insulin resistance leads to increased flux of free fatty acids and hence the lipid changes<sup>[6]</sup>. Coronary artery disease is the leading cause of cause of death and disability among adults<sup>[7]</sup>. Serum cholesterol, low-density lipoprotein-cholesterol (LDL-C) and High serum triglycerides are major risk factors of this cardiovascular disease. Reduction of lipid profile is important both in the prevention and control of coronary heart disease<sup>[8]</sup>. Life style changes is the key in the prevention and treatment for hypercholesterolemia and other risk factors<sup>[9]</sup>. There is a rise in dementia cases throughout the world. Alzheimer's is the major form of dementia. Alzheimer's is a progressive neurodegenerative disease that results in steady cognitive decline<sup>[10]</sup>. Mini-cog is a simple test that is administered to identify Alzheimer's from other forms of dementia<sup>[11]</sup>. In USA alone there are 6 million Alzheimer's patients and every 30 seconds a new Alzheimer's patient is diagnosed. There is an increase in Alzheimer's prevalence in India<sup>[2]</sup>.

However, due to inaccuracy of data collection, the exact number is still a question of debate. The link between Alzheimer’s, dyslipidemia and diabetes are have been reported earlier.

Salat is an obligatory mindful physical activity prescribed 5 times a day from dawn to dusk [12]. Before each session of salat ablution (washing with water) of hands, mouth, nostrils, face, massage of inner portion of ears, back of the neck and finally washing of feet is a must. Each session of salat include mindful repetitive body movements: standing, kneeling, prostration, relaxation and meditation. During these movements, a strict focus on the mind is a primary condition [12]. Prolonged and intentional distraction from the focus will nullify the salat. Mindful meditation and mindful physical activities of other kind hasbeenstudiedforseveraldecades for their role in the management of chronic diseases including dementia [13].

**II. MATERIALS AND METHODS**

This study was conducted at Kannur medical college. All subjects recruited locally from the villages around the medical college and hospital. Subjects were randomly divided into two groups. Salat group (SG), the group that underwent salat practice (n=50). The remaining subjects act as control group or NSG (n=50). The SG-group was put on salat practice for 12 months. The subjects of the NSG-group were default non-salat practicing as they were the adherents of another sect who do not practice salat. Both groups were on non-vegetarian dietary habits, non-alcoholic and non-smokers.

Blood sugar (fasting plasma glucose, post-prandial blood sugar) and lipid profile (total cholesterol, triglycerides, low-density lipoprotein, very low-density lipoprotein, high-density lipoprotein) data was collected at baseline and at the end of 12 months. Cognitive assessment data was collected by administering a simple clinical diagnostic tool, mini-cog. The mini-cog data is shown in (Table-1). All clinical and biochemical tests were performed at the central laboratory of the Kannur Medical College super speciality hospital.

**III. STATISTICS**

Statistical measurements were done using SPSS software. Mean and SD of the selected variables, descriptive statistics was used. In all the cases 0.5 levels of significance were fixed.

**Table-1 Mini-Cog Score In Sg and Nsg Groups Before and After The Trial**

Mini-cog	SG Mean n=50		NSG Mean n=50	
	Pre Test	Post Test	Pre Test	Post Test
Word Recall Score*	2.0	3.0	1.5	1.5
Clock Draw Score**	2.0	2.0	2.0	1.0
Total Score Out of 5	4.0	5.0	3.5	2.5

\*Maximum Score is 3 points, \*\*Maximum score is 2 points  
SG= Salat Group; NSG= Non-Salat Group. Pre-test = day one of start of trial, Post-test = At the end of 12-month trial

**IV. RESULTS**

Using ANCOVA, the F ratio for adjusted post-test means in Fasting Plasma Sugar (FPS) and Post-Prandial Blood Sugar (PPBS) of the subjects were 4.17 and 7.56 respectively, which were significant at 0.05 levels (Table-2). Using ANCOVA, the F ratio for adjusted post-test means in Total Cholesterol (TC), Triglycerides (TG), Low-Density Lipoprotein (LDL), Very Low-Density Lipoprotein (VLDL), High-Density Lipoprotein(HDL) of the subjects were 21.85, 16.17, 18.22, 8.12, 20.53 respectively (Table- 4), which was significant at 0.05 levels. The above analysis of the data indicated that there was a significant difference in the adjusted post-test means among SG-Salat group and NSG-control group. Further, to determine which of the paired means had a significant difference, the LSD post hoc test was applied (Table-3 and Table-5).

**Table – 2: Descriptive Statistics and Analysis of Covariance for the Pre-znd Posttest Data of Blood GLucose of Salat Group (Sg)and Control Group (Nsg)**

Blood Sugar	SG GROUP		NSG GROUP		F-value
	Pre-Test	Post-Test	Pre-Test	Post-Test	
FPG	168.30 ± 14.86	158.50 ± 11.70	165.30 ± 27.34	165.50 ± 27.03	4.17*
PPBG	236.80 ± 42.60	228.70 ± 42.70	235.60 ± 25.97	236.20 ± 26.67	7.56*

SG= Salat Group; NSG= Non-Salat Group. Pre-test = day one of start of trial  
Post-test = At the end of 12-month trial. \* Significant at the 0.05 level

**Table-3: Lsd Test For The Differences Between the Adjusted Post-Tests Paired Means Of Blood Glucose.**

Blood Sugar	Adjusted Post-test Means		Mean Differences	Standard Error
	SG	NSG		
FPS	156.981	166.662	-9.681*	3.313
PPBS	227.509	236.200	-8.691*	1.605

SG= Salat Group; NSG= Non-Salat Group.

\* Significant at the 0.05 level

**V. DISCUSSION**

In the light of the importance of mindful physical activity in the amelioration of dementia [14] and on the positive influence on blood glucose and lipid parameters [15, 16] this study was carried out. The results show that 12-months of salat practice resulted in significant (p ≤ 0.05) decrease in FPS and PPBS (Table-2) values in SG-group. Since salat involves physical activity with highly disciplined focused meditation and exposing on-self to water prior to every session of salat, it might induce some sort of

neural activity at the level of skin, and the repetitive physical activity may rejuvenate pancreatic cells and increase burning of calories affecting lipids and the focused meditation may reduce stress and increase the neuron activity in the brain especially the frontal lobe which is adversely affected in Alzheimer’s. In salat touching of forehead (the prostration) is considered as the act of highest value. Results also show that there may be increase in utilization and metabolism of glucose in the peripheral tissues, liver and adipose tissues through enzymatic process [12].

**Table - 4: Descriptive Statistics and Analysis of Covariance for the Pre and Post Test Data of Lipid Profiles Of Sg Group And Nsg-Group**

Lipid Profiles	SG-Group		NSG-Group		F-value
	Pre -Test	Post -Test	Pre-Test	Post -Test	
TC	206.90 ± 30.94	201.80 ± 31.70	207.80 ± 36.90	207.90 ± 36.50	21.85*
TG	166.90 ± 28.62	161.90 ± 27.87	159.70 ± 23.64	160.20 ± 23.67	16.17*
LDL	127.50 ± 15.11	123.70 ± 14.89	125.10 ± 17.21	125.00 ± 17.62	18.22*
VLDL	35.00 ± 4.47	32.70 ± 3.74	33.90 ± 3.73	33.90 ± 3.25	8.12*
HDL	47.60 ± 3.66	51.20 ± 3.55	47.40 ± 3.37	47.30 ± 3.33	20.53*

SG= Salat Group; NSG= Non-Salat Group. Pre-test = day one of start of trial

Post-test = At the end of 12 -month trial. \* Significant at the 0.05 level

**Table -5: Lsd Test for the Differences Between the Adjusted Post- Tests Paired Means of Lipid Profiles**

Lipid Profiles	Adjusted Post-test Means		Mean Differences	Standard Error
	SG	NSG		
TC	200.86	206.06	-5.20*	0.733
TG	157.45	162.76	-5.31*	0.727
LDL	123.23	126.94	-3.71*	0.512
VLDL	32.48	34.56	-2.08*	0.519
HDL	51.35	47.64	3.71*	0.570

SG= Salat Group; NSG= Non-Salat Group. Pre-test = day one of start of trial

Post-test = At the end of 12 -month trial. \* Significant at the 0.05 level

Muscular relaxation, development and improved blood supply to muscles might enhance insulin receptor expression on muscles causing increased glucose uptake by muscles and thus reducing blood sugar. The significant ( $p \leq 0.05$ ) decreases in TC, TG, LDL and VLDL values coupled with significant ( $p \leq 0.05$ ) increase in HDL (Table-5) in our participants imply an improved lipid profile having good prognostic value. This decrease of ‘bad’ cholesterol and a concomitant increase in ‘good’ cholesterol has significance when viewed in the light of the cardiovascular risk profile of diabetic patients. It has been previously reported that other types of mindful physical activities may have preventative and protective effects on diabetes mellitus by decreasing oxidative stress and improving antioxidant status<sup>[17]</sup>. A similar mechanism may be working in our patients as a systematic review also found the effects of training to be more prominent regarding fasting blood glucose level and lipid profile<sup>[18]</sup>. The decrease in lipid profile seen in this study also agrees with the effect of mindful exercises of other types reported earlier. Earlier reports showed significant reduction in free fatty acids, LDL, VLDL and an increase in HDL<sup>[19, 20]</sup>. The improvement in the lipid profile could be due to increased hepatic lipase and lipoprotein lipase at cellular level, which affects the metabolism of lipoprotein and thus increase uptake of triglycerides by adipose tissues. These changes suggest improvement in the insulin sensitivity following mindful exercises.

Higher mini-cog score, lower lipid levels and low blood sugar in the salat group indicates that long term practice of salat prevent cognitive decline as compared to the non-salat group. Though both SG group and NSG group scored same in the clock draw test before and after the trial period, but the word-recall test score was lower in the NSG group at the end of the trial period. This strongly suggests that in the NSG group there was a steady cognitive decline. Whereas in the SG group the word-recall improved over time, indicating a positive role for salat in cognitive protection. Stress in the daily life may result in slow and steady destruction of brain cells leading to cognitive decline<sup>[21]</sup>. The same stress may be responsible for increase in lipids and blood glucose. In the salat group, subjects are used to breaking their chain of stress at five different times of the day from dawn to dusk, thus minimizing the deteriorating impact of daily stress<sup>[12]</sup>. Earlier we have reported that long-term practice of salat improves lipid profile and may prevent Alzheimer’s in humans<sup>[22]</sup>. However, further studies are needed to fully understand the role of salat on dementia related disorders including Alzheimer’s.

## VI. CONCLUSION

Data obtained in this study shows that long term practice of Salat, a mindful moderate regular physical activity, may reduce hyperlipidemia, a risk factor of cardiovascular disease. Salat may also prevent diabetes by improving glycemic control and induce insulin production, which need further studies. Salat may provide cognitive protection through the mindful meditative activities and pro-gravity prostrations, which may prevent neuronal death, stop cognitive decline and Alzheimer’s in later stages of life. Salat is a simple and brief activity which has elements of hygiene, concentration, meditation, physical activity all bundled in a package. Salat can be performed at any place any time and by anyone requiring no special preparation. Therefore, salat can be used an adjunct inexpensive preventative therapy for a wide range of physical, mental and metabolic disorders.

## ACKNOWLEDGMENT

Authors are thankful to Swasth Hindustan Mission and Kannur Medical College, Kerala for the support in conducting this study.

## CONFLICT OF INTEREST

Authors have not received any funding from any source and have no conflict of interest.

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