Effect Of Yoga On Beta Cell Functioning In NIDDM

Dr. Vimal Borgaonkar* , Dr. Abhijit Deshpande**, Dr. Ulka Natu**, Rajiv Dixit***, Nushafreen Irani*****, Neela Tahmane***,**

*Medical Director, **Research Director, ***Research Co-ordinator, Ghantali Mitra Mandal, Thane,****Director, ***** Research Co-ordinator, International Institute of Sleep Sciences, Thane

Abstract: Introduction: The current study is undertaken to study the effect of yoga on B-cells for Diabetes with Type-2 population. Material and Methods: Total 83 participants with age group of 30-70yrs meeting the criteria for NIDDM with criteria published by American Diabetic Association were screened for the study. Exclusion criteria were those already practicing yoga one month prior to the trial, using medication known to stimulate β cells and pregnant women. Systematic protocols of yogic interventions were given for 3 months. Those who were present for period of one month were included for analysis. Result: After applying criteria total 34 number of participants were enrolled in the study. Of these 32 completed the intervention for more than one month and were included in the final analysis. These included 59.37% (N=19) female participants and 40.62% (N=13) male participants. T-test using SPSS showed statistical significance data for activation of B-cells with no significant change in insulin resistance and insulin sensitivity. Other statistical significant changes were observed in triglycerides, total cholesterol, hemoglobin and Fasting Insulin while non-significant for BMI, HbA1c and C.Peptide. Conclusion: The study successfully showed the effect of yoga on physiological changes in the body post intervention. Effect on the beta cells activation was notable. . [Paletkar T Natl J Integr Res Med, 2019; 10(2):16-20]

Key Words: Diabetes, Yoga, Beta cell, insulin resistance, pancreas, HBA1c

Author for correspondence: Dr.Abhijit Deshpande, International Institute of Sleep Sciences. Thane, Mumbai. Maharastra. Email id: abhijitd1965@gmail.com M:9594616959

Introduction: The healthcare burden of T2DM is highly significant and there is widespread evidence that conventional approaches to its management have been inadequate[1].

Traditionally, T2DM is viewed as a progressive disease. Pathogenesis is complex, characterized by genetic predisposition that—together with metabolic abnormalities associated with body-weight gain, defective insulin secretion and action, and elevated endogenous glucose production—eventually compromises glucose homeostasis[2].

Two major pathophysiologic abnormalities underlie most cases of type 2 diabetes (T2D): *1*) insulin resistance and *2*) defects in pancreatic β-cell function. The current consensus is that both are essential components in disease pathogenesis even if their relative importance, the precise temporal sequence of events, and underlying mechanisms vary considerably in different populations and individual patients[3].

Evidence from both human and animal studies suggests that T2DM is characterized by decreased functional β-cell mass that cannot adapt insulin secretion to compensate for increasing insulin resistance driving the development of overt T2DM[4].

β-Cell function continues declining progressively despite treatment with antidiabetic medications as highlighted in the 1995 United Kingdom Prospective Diabetes Study (UKPDS) [5].Amongst the pharmacological interventions, Thiazolidinedione drugs have been shown to preserve or increase beta cell function[6]. Moderate as well as vigorous intensity exercises have been shown to improve beta cell function indices[7].

Mechanisms For Beta Cell Failure: Progressive β-cell failure in T2DM stems from both genetic and acquired factors. Genes include those encoding for glucose metabolism proteins, molecules of the insulin-signaling pathways, and transcription factors[8].Among acquired factors, glucose toxicity, lipotoxicity, increased islet amyloid polypeptide (IAPP) deposition, and inflammatory cytokines are most often cited as contributors to β-cell failure[9].

Known Effects Of Yoga: Effect of Yoga on LIPOTOXICITY: The decrease in free fatty acid levels also reduces the lipotoxicity, which has now been shown to have a significant effect on beta cell function[10].

Effect of Yoga on Inflammatory Cytokines: A yoga-based lifestyle intervention seems to be a highly promising alternative therapy which

favorably alters inflammatory markers and metabolic risk factors[11].

Effect of Yoga and other physical activity on Amyloid deposition: In Pre-clinical Alzheimer's patients, the deleterious effect of aging on AD biomarkers such amyloid deposition and cognition is attenuated among physically active middle-aged adults at risk for AD compared with their fewer active peers[12]. In healthy volunteers, Yogasana practices have shown to increase in the release of insulin from beta cells[13].

Hypothesis: Yoga practices are shown to be effective in preventing lipotoxicity, deleterious effects of inflammatory cytokines and deposition of amyloid. All of these are implicated in Beta cell dysfunction. In healthy population, Yoga practices improve insulin release. Therefore, Yoga practices may improve Beta cell functionality in diabetic population.

Materials and Methods: Ethics: The Study was approved by Independent Ethics Committee of International Institute of Sleep Sciences, DCGI approved and consent of the participants was taken before starting with the study.

Study Design: This was a prospective, single-arm, interventional study conducted at the Ghantali Mitra Mandal, Thane, India and International Institute of Sleep Sciences (IISS), Thane, India.

Study Population: Participants were men and women diagnosed with NIDDM with criteria published by American Diabetic Association[14] in last six months of screening phase, not practicing Yoga or Meditation for one month prior to intervention and were in the age group between 30 years to 70 years. Those who were using medicines which are known to stimulate Beta cells such as Amylin mimetics, Sodium glucose transporter 2 inhibitors, Incretin mimetics., Dipeptidyl-peptidase 4 inhibitors, Sulfonylureas., Glinides were excluded from the study. Pregnant women and those who refused proper contraception during study interval were excluded.All participants could continue with their routine physical exercises and diet provided they followed the same exercise schedule and exercise intensity as well as diet throughout the study period.

Yogic Intervention: Yogic intervention consisted of the following sequential practices. The details are given in Table 1 Below.

Table 1: Yogic Intervention

Practices	Duration	Frequency
Trataka- Burning Flame in Eyebrow centre, Chanting of Om.	5- 6 min.	Daily
Recitation of Mantra with Sankalpa. Mahamrutyunjaya- 3 times Gayatri -3 times 32 names of Goddess Durga -1 time	7-8 min	Daily
Anti- Rheumatic practices with breath awareness. (Pawan Muktasana -1) for legs, Hands, Neck and waist Joints.	10 min	Daily alternative practices in the set of : 5 times at physical level. 5 times at mental level. 5 times with visualising perfect practices.
Surya Namaskara	10 min	2-3 sets of 2 Surya Namaskara
Cleansing practices- Udiyan, Agnisar.	2 min.	Daily after Surya Namaskara
Short Relaxation (Shavasana)	2 Min	Daily.
Asanas	15 min.	Daily. Set of asanas was practised on alternate day.
Pranayam	15 min	Daily
Yoganidra	15min	Daily
Ajapajap, Closing Prayer (Shantipath)	17 min	Daily.
Cleansing practices- Vaman, Jalneti and Laghu Shankha Prakshalana.	Specially taken on Sundays.	Twice in the course of 3 months.
Japa on beads, Daily at night - quick review of own behaviour.	--	Daily at home.

Study Implementation: The specially designed yoga module was practiced at Yoga Hall at Sahayoga Mandir, Thane, Maharashtra, for 3 months commencing from 15th April to 14th July 2018. The yogic practices were being carried out daily for six days in a week for one and half hour from 6.00 to 7.30 am. Before conducting the study, a programme was conducted to educate the participants about yoga and its benefits for diabetics. There were 83 participants which were screened with NIDDM. Out of which 34 participants were included in the study. Biochemical variables i.e. fasting blood glucose, postprandial blood glucose, glycosylated hemoglobin (HbA1C), C. Peptide, cholesterol, and triglycerides were included in the study.Fasting blood samples were collected in the beginning of the study as well as at the end of the study.

End Points: Primary end point of the study was to assess effect of Yogic intervention on Pancreatic Beta cell functioning with simultaneous measurement of Insulin sensitivity as measured by Homeostatic model after practicing the intervention for 90 days.

Secondary end points were to assess change in lipid profile, Hb1AC levels as well as body mass index. Other end point was tolerability of intervention and noting any adverse events if any.

Measuring Beta Cell Function: Currently, β-cell function is variably assessed using fasting indices derived from insulin and glucose values, dynamic testing with oral glucose or standardized meals, and responses following intravenous glucose infusions[15].

Homeostatic model assessment (HOMA) is a method for assessing β-cell function and insulin resistance (IR) from basal (fasting) glucose and insulin or C-peptide concentrations[16] .The requirement of single measurement of fasting glucose and either fasting insulin or C-Peptide level makes this method easy and efficient logistically. Indeed, it has been used in more than 500 publications.

HOMA has been used to assess longitudinal changes in -cell function and IR in patients with diabetes in order to examine the natural history of diabetes and to assess the effects of treatment. For example, the model was used in the U.K. Prospective Diabetes Study (UKPDS) to demonstrate the effects of sulfonylureas and metformin on IR and -cell function, compared with diet, over a 6-year period[5].

As per the guidelines given, Beta cell function must be assessed along with Insulin sensitivity value. Correct conclusions should be drawn in context of the sensitivity value. An example given by the authors is as follows: “It can be seen from the model that for individuals with normal glucose levels, HOMA solutions might indicate 100% -cell function and 100% insulin sensitivity or, in the case of a thin, fit individual with high sensitivity, 50% -cell function and 200% insulin sensitivity. Within the context of reporting both results, these are appropriate solutions—sensitivity is doubled, so the -cells are functioning at 50% of normal. However, if the -cell data are reported in isolation, one might conclude erroneously that the subject had failing -cells, as opposed to appropriately low secretion, because the sensitivity of the body was high”[16].

Fasting blood samples were drawn pre and post intervention for Lipid profile, Hb1AC and routine blood parameters.

Statistical methodology: This was a pilot observational study to see effect of yogic intervention on Beta cell functioning. The study used Statistical Program for Social Sciences (SPSS), Version 11.5 for Windows for statistical analysis with alpha value set at <0.05. The test applied was T-test to check for statistical analysis pre and post yogic intervention.

Results : In the end of the study number taken with intent to treat analysis were 32. As two participants did not complete 4 weeks of intervention they were not included in the analysis. These included 59.37% (N=19) female participants and 40.62% (N=13) male participants.(Table 2)

Discussion: Patho-physiology of NIDDM has two major components. Beta cell dysfunction has gained considerable attention as new therapies targeting beta cells emerge.

By the time diabetes is diagnosed, majority patients will have lost the beta cell functioning by 40 to 50%[17].This study group showed average Beta cell function at 59% at the beginning of the study or loss of 41% at the beginning of the study.

Table 2: Pre yoga and Post Yoga Comparison of different Blood Parameter

Blood Test Parameters	*(Sample Size = 32)*		
	Pre Yoga	**Post Yoga**	**P value***
BMI	25.95+/- 6.21	24.07+/- 8.68	0.263
Triglycerides	184.89+/- 87.58	133.20 +/- 60.08	0.0000
Total Cholesterol	201.11 +/- 42.6	172.85 +/- 36.25	0.0000
HbA1C	7.51 +/- 1.17	8.09 +/- 1.67	0.5
C. Peptide	2.53 +/- 1.12	2.55 +/- 1.04	0.87
Hemoglobin	12.67 +/- 1.57	12.92 +/- 1.64	0.0020
Beta Cells	63.94 +/- 26.29	70.64 +/- 28.06	0.026
Sensitivity	53.88 +/- 21.94	55.01 +/- 23.43	0.52
Fasting	150.74 +/- 38.75	142.69 +/- 37.71	0.038
Insulin Resistance	2.18+/- 0.99	2.14 +/- 0.90	0.687
*P<0.005 is considered as statistical significant difference			

Major finding of our study is that Yoga intervention showed statistically significant improvement in the beta cell function in context of other parameters such as insulin sensitivity and insulin resistance which did not show statistically significant improvement.

There are many studies on Yoga intervention in diabetic population. However, to our knowledge, this is first study looking specifically for patho-physiological changes after intervention in NIDDM population.

The findings from the study show that there is statistically significant reduction in levels Of serum triglycerides, reducucing the lipotoxicity. These parameters are shown to be changed with moderate to vigorous exercise. Therefore, it seems clear, at least in the present study, that the greater improvement in beta cell functioning resulting from yoga cannot be explained by the factors more favorably modulated by vigorous exercise.

Glucotoxicity is a mechanism for reduction in beta cell function. Reduction in average sugar levels could be one of the factors that explain beta cell improvement. Numerous studies have shown yoga to have an immediate effect on down regulating the response of SNS -HPA axis to stress. Studies show that yoga decreases levels of salivary cortisol, blood glucose as well as plasma renin levels, and 24-hour urine norepinephrine and epinephrine level[18].

Thus, yogic practices should not be considered with aerobic exercises as having similar beneficiary effect in diabetic population as mechanism of action seems to be different. Long term practices probably would be more beneficial as they would help reduce HBA1c values.

This study was an observational prospective study with many limitations. Smaller number of subjects, lack of control group is some of the shortcomings. None the less, our study's merits include study design with intent to treat analysis. Future randomized, controlled studies with higher numbers are needed to confirm these findings.

References:

1. Resnick HE, Foster GL, Bardsley J, Ratner RE. Achievement of American Diabetes Association clinical practice recommendations among US adults with diabetes, 1999–2002: the National Health and Nutrition Examination Survey. Diabetes care. 2006 Mar 1;29(3):531-7.
2. Weyer C, Bogardus C, Mott DM, Pratley RE. The natural history of insulin secretory dysfunction and insulin resistance in the pathogenesis of type 2 diabetes mellitus. The Journal of clinical investigation. 1999 Sep 15;104(6):787-94.
3. Philippe A. Halban Kenneth S. Polonsky Donald W. Bowden Hawkins Charlotte Kieren J. Mather Alvin C. Powers Christopher J. Rhodes Lori SusselGordon C. Weirβ-Cell Failure in Type 2 Diabetes: Postulated Mechanisms and Prospects for Prevention and Treatment The Journal of Clinical Endocrinology & Metabolism, Volume 99, Issue 6, 1 June 2014, Pages 1983–1992.
4. Thorens B. The required beta cell research for improving treatment of type 2 diabetes.

Journal of internal medicine. 2013 Sep;274(3):203-14..
5. UK Prospective Diabetes Study Group. UK Prospective Diabetes Study 16: overview of 6 years' therapy of type II diabetes: a progressive disease. Diabetes. 1995 Nov 1;44(11):1249-58.
6. Buchanan TA, Xiang AH, Peters RK, Kjos SL, Marroquin A, Goico J, Ochoa C, Tan S, Berkowitz K, Hodis HN, Azen SP. Preservation of pancreatic β-cell function and prevention of type 2 diabetes by pharmacological treatment of insulin resistance in high-risk Hispanic women. Diabetes. 2002 Sep 1;51(9):2796-803.
7. Slentz CA, Tanner CJ, Bateman LA, Durheim MT, Huffman KM, Houmard JA, Kraus WE. Effects of exercise training intensity on pancreatic β-cell function. Diabetes care. 2009 Oct 1;32(10):1807-11.
8. Sladek R, Rocheleau G, Rung J, Dina C, Shen L, Serre D, Boutin P, Vincent D, Belisle A, Hadjadj S, Balkau B. A genome-wide association study identifies novel risk loci for type 2 diabetes. Nature. 2007 Feb;445(7130):881.
9. Weir GC, Laybutt DR, Kaneto H, Bonner-Weir S, Sharma A. Beta-cell adaptation and decompensation during the progression of diabetes. Diabetes. 2001 Feb 1;50(suppl 1):S154.
10. Angadi P, Jagannathan A, Thulasi A, Kumar V, Umamaheshwar K, Raghuram N. Adherence to yoga and its resultant effects on blood glucose in type 2 diabetes: a community-based follow-up study. International journal of yoga. 2017 Jan;10(1):29.
11. Shete SU, Verma A, Kulkarni DD, Bhogal RS. Effect of yoga training on inflammatory cytokines and C-reactive protein in employees of small-scale industries. Journal of education and health promotion. 2017;6.
12. Okonkwo OC, Schultz SA, Oh JM, Larson J, Edwards D, Cook D, Koscik R, Gallagher CL, Dowling NM, Carlsson CM, Bendlin BB. Physical activity attenuates age-related biomarker alterations in preclinical AD. Neurology. 2014 Nov 4;83(19):1753-60.
13. Okonkwo OC, Schultz SA, Oh JM, Larson J, Edwards D, Cook D, Koscik R, Gallagher CL, Dowling NM, Carlsson CM, Bendlin BB. Physical activity attenuates age-related biomarker alterations in preclinical AD. Neurology. 2014 Nov 4;83(19):1753-60.
14. American Diabetes Association. Standards of Medical Care in Diabetes-2018 Abridged for Primary Care Providers. Clinical diabetes: a publication of the American Diabetes Association. 2018 Jan;36(1):14..
15. Roden M, editor. Clinical diabetes research: methods and techniques. John Wiley & Sons; 2007 Aug 20.
16. Wallace TM, Levy JC, Matthews DR. Use and abuse of HOMA modeling. Diabetes care. 2004 Jun 1;27(6):1487-95.
17. Holman RR. Assessing the potential for α-glucosidase inhibitors in prediabetic states. Diabetes research and clinical practice. 1998 Jul 1;40:S21-5.
18. Ross A, Thomas S. The health benefits of yoga and exercise: a review of comparison studies. The journal of alternative and complementary medicine. 2010 Jan 1;16(1):3-12.

Conflict of interest: None

Funding: None

Cite this Article as: Borgaonkar V , Deshpande A, Natu U, Dixit R, Irani N, Tahmane N. Effect Of Yoga On Beta Cell Functioning In NIDDM. Natl J Integr Res Med 2019; Vol.10(2): 16-20