National Journal of Physiology, Pharmacy and Pharmacology

RESEARCH ARTICLE

Beneficial effects of yogasanas and pranayama in limiting the cognitive decline in Type 2 diabetes

Rajani Santhakumari Nagothu[1], Archana Rajagopalan[2], Yogananda Reddy Indla[3], Rajesh Paluru[4]

[1]Department of Physiology, MediCiti Institute of Medical Sciences, Ghanpur, Ranga Reddy, Telangana, India, [2]Department of Physiology, Saveetha Medical College, Thandalam, Chennai, Tamil Nadu, India, [3]Department of Physiology, SVS Medical College, Mehabubnagar, Telangana, India

Correspondence to: Rajani Santhakumari Nagothu, E-mail: rajaniprabath@gmail.com

Received: August 20, 2016; **Accepted:** September 08, 2016

ABSTRACT

Background: Out of many complications that were observed in Type 2 diabetes, cognitive impairment is the most neglected. **Aim and Objectives:** The aim of the present study is to assess the cognitive decline in Type 2 diabetes and to observe the role of yogasanas and pranayama in ameliorating the cognitive decline. **Materials and Methods:** A total of 68 Type 2 diabetic patients were recruited in the study, 34 of them did specific yogasanas and pranayama (test group) for 6 months, and the remaining age- and sex-matched 34 patients were recruited as (control group) who were not on any specific exercise regimen. Glycemic index was estimated by measuring the glycosylated hemoglobin (HbA1c) concentration with Bio-Rad apparatus and cognition were assessed using Addenbrooke's cognitive examination-revised (ACE-R), which is a neuropsychological battery. Data were analyzed with unpaired student *t*-test. $P < 0.05$ is considered as statistically significant. Validity was assessed by receiver operating characteristics. **Results:** Analysis of data indicated more cognitive scores in the test group when compared with the control group. In test group, 6 months practice of yogasanas and pranayama has also significantly brought down the high glycemic values which were observed in the control group. **Conclusion:** These findings allow the study to conclude that regular practice of yogasanas and pranayama has a beneficial effect on cognitive performance in Type 2 diabetic patients by stabilizing blood glucose.

KEY WORDS: Addenbrooke's Cognitive Examination-Revised; Cognition; Glycosylated Hemoglobin; Type 2 Diabetes; Yogasanas and Pranayama

INTRODUCTION

Type 2 diabetes mellitus is the result of nonresponsiveness by the peripheral tissues to the secreted insulin or because of decreased insulin production from the pancreas; it is also called as non-insulin-dependent diabetes mellitus or adult-onset diabetes.[1] Globally, 382 million people are suffering with diabetes, and 90% of them are Type 2 diabetics; it is expected that 592 million people are going to be affected with diabetes by 2035.[2] Diabetes affects the central nervous system, which includes damage to cranial nerves, brain, spinal cord, and autonomic neuropathy. Apart from these, many specific regions of the brain get damaged either by demyelination, atrophy or by accumulation of oxidative end products resulting in alteration in brain metabolites.[3] All of these can result in cognitive decline. Cognition can be defined as the processes an organism uses to organize information, which includes perception, attention, understanding, and retaining information, and it can be used to guide the behavioral aspects of the persons.[4] Cognitive decline is 1.2-1.5 fold more in diabetic patients than the normal individuals.[5] Cognitive function assessed

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2017.7.0825508092016	

by Addenbrooke's cognitive examination-revised (ACE-R). Since its inception a decade ago, ACE-R has been translated into various languages and widely used in detecting cognitive impairment. Unfortunately, clinicians are not advising cognitive screening for diabetics as many of them are blindly ignoring the significance of cognition rather understanding its role in one's life. Earlier studies have proven that specific yogasanas and pranayama can be used as a therapeutic measure in treating endocrine, physical, physiological, psychological elements if it is done over a period of time.[6,7] Stabilization in basic biochemical levels of the parameters and correcting the metabolic derangement might have contributed to the positive outcomes that were observed with yogasanas and pranayama.[8] Therefore, the present study was undertaken to assess the cognitive decline in Type 2 diabetics and also to observe the beneficial effects of specific yogasanas and pranayama in limiting the cognitive decline in Type 2 diabetes.

MATERIALS AND METHODS

The present study was approved by the institutional ethical committee, and the patients were recruited after obtaining the written informed consent. 68 Type 2 diabetic patients were recruited in the study, 34 of them (test group) practiced specific yogasanas and pranayama for 45-60 minutes/day, for 6 days in a week, over a period of 6 months. They did yogasanas, namely, Dhanurasana, Naukasana, Arthamasthendrasana, and Bhujangasana which were mentioned in Table 1 and pranayama, namely, Anuloma-Viloma, Surya Anuloma-Viloma, Chandra Anuloma-Viloma, and Nadishuddi pranayama which were mentioned in Table 2, for 6 months under the supervision of yoga expert. These yogasanas and pranayama were selected based on their beneficial effects in diabetes by the earlier research work by Sahay et al., 2007. Age-, sex-, and years of education-matched 34 Type 2 diabetic patients who were not on any specific exercise regimen were included in the study as a control group. Control group patients were selected from the same locality; this precaution was taken to minimize the effects of cultural, socioeconomical, and educational status on cognition between the test and control groups. Both test and control group patients are taking oral hypoglycemic agents since they were diagnosed as diabetic patients. Inclusion criteria: Type 2 diabetes patients aged between 35 and 65 years, both the sex, minimum duration of diabetes is 2 years, glycosylated hemoglobin (HbA1c) >6 were included in the study. Exclusion criteria: Cognitive impairment from childhood, other endocrine disorders, the recent history of major surgeries, ACE-R score <82, smoker's, alcohol consumer's, and Type 2 diabetics who are on insulin treatment.

HbA1c levels were estimated using the Bio-Rad D-10™ HbA1c program, and it is intended for the percent determination of HbA1c in human whole blood using ion-exchange high-performance liquid chromatography. Cognition will be assessed using ACE-R, a neuropsychological battery, by considering attention/orientation (18 points), language

Table 1: List of yogasanas and their duration

Name of yogasana	Duration
Dhanurasana	1/2-1 minute for the pose being maintained, adding 1/2 minute/week
Naukasana	2-4 turn of each, the pose being maintained for ten seconds adding one turn each, every fortnight
Arthamasthendrasana	1/4-1 minute for each side, adding 1/4 minute/week
Bhujangasana	2-4 turn of each, the pose being maintained for 10 s adding one turn each, every fortnight
Name of relaxation asana	
Shavasana/Makarasana	3 turn of each, the pose being maintained for 30 s

Table 2: List of pranayamas and their duration

Name of pranayama	Duration
Anuloma-Viloma	2-5 minutes
Surya Anuloma-Viloma	5 minutes
Chandra Anuloma-Viloma	5 minutes
Nadishuddi pranayama	10 minutes

Table 3: Cognitive test scores

Cognitive scores	Control group	Test group	*P*
ACE-R	85.3±2.4	92.88±4.49	<0.0001*
MMSE	24.9±1.8	27.29±1.75	<0.0001*
Attention/orientation	15.38±1.8	16.76±1.3	<0.001*
Memory	21.38±2	24.02±0.31	<0.0001*
Fluency	12.35±1.8	12.91±1.4	<0.16
Language	23±2.1	24.9±0.93	<0.0001*
Visuospatial function	12.85±2.4	14.32±1.6	0.005*

Unpaired student *t*-test was done to observe the differences in mean values in between test and control group (*P<0.05 was considered as statistically significant). MMSE: Mini-mental state examination, ACE-R: Addenbrooke's cognitive examination-revised

Table 4: Different parameters of study patients

Parameter	Control group	Test group	*P*
Age (in years)	49.05±0.5	47.4±7.98	0.41
Duration (in years)	5.56±2.6	5.57±2.7	0.78
SBP (mm Hg)	134.12±12	120.60±10	0.04*
DBP (mm Hg)	80.2±6.6	74.8±6	0.01*
HbA1c	7.79±1.84	6.02±0.49	0.0001*
Pulse/minutes	82.11±8	78.4±5	0.02*

Unpaired student *t*-test was done to observe the differences in mean values in between test and control group (*P<0.05 was considered as statistically significant)

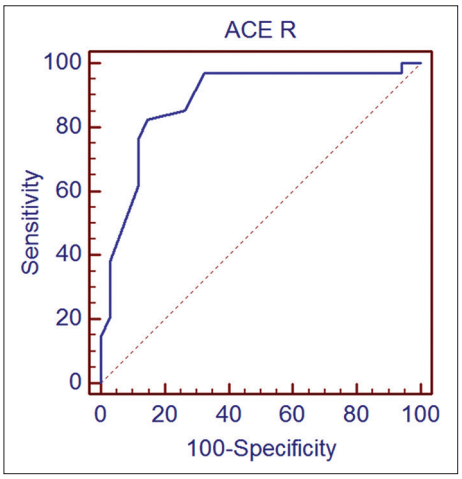

Figure 1: It illustrates the sensitivity and specificity of Addenbrooke's cognitive examination-revised

(26 points), memory (26 points), verbal fluency (14 points), and visuospatial (16 points) domains. It takes around 15 minutes to administer the test and having a maximum score of 100. Scores above 88 are considered as normal cognition. Scores from 88 to 83 are considered with mild cognitive impairment and scores ≤82 are with dementia.[5] ACE and ACE-R were been translated into many languages worldwide, including Indian regional languages such as Malayalam,[9] Hindi, and Telugu, and thus, these translations are useful in assessing the cognition in a large number of independent cohort studies (Table 3). In addition, yoga has been studied for controlling both the symptoms and the complications associated with Type 2 diabetes mellitus.[10] For those who can speak only local language (Telugu), we adopted ACE-R.

Setting

The study was conducted at the MediCiti Institute of Medical Sciences, Hyderabad, and intervention was given at the Yogi Vemana Yoga Research Institute, Hyderabad.

Statistical Analysis

Statistical analysis was conducted using MedCalc Statistical Software version 12.7.8 (MedCalc Software bvba, Ostend, Belgium; http://www.medcalc.org; 2014). Unpaired student *t*-test was done to observe the differences in mean values in between test and control group; $P<0.05$ was considered as statistically significant. Then, receiver operating characteristics (ROCs) were done.

RESULTS

Area under the ROC curve is a measure of diagnostic accuracy, and it was found out to be 0.88. The cut-off scores were got to be 88/100 and it is justified on the basis of this study that it did not include a normal control group, and hence, it shows more representative of day-to-day clinical practice. ACE-R is effective in diagnosing cognitive impairment in Type 2 diabetics with a sensitivity of 82.35 (95% CI: 65.5-93.2) and specificity of 85 (95% CI: 68.9-95.0) at a cut-off value of 88 (Figure 1). Sensitivity of the test is less compared to the previous studies and that is because of the less sample size (34). Sensitivity is 100% at a cut-off value of 82 but showed a poor specificity. Sensitivity and specificity were not done at all ACE-R scoring levels, as our sample size is less, and also the study did not include the patients with lesser ACE-R scores that is <82.

ACE-R also includes Mini-Mental State Examination (MMSE), so comparison of the MMSE scores of test and control groups was also done. MMSE scores, individual attention/orientation scores, verbal fluency scores language scores, and visuospatial scores HbA1c levels were significantly improved in test group followed by intervention.

DISCUSSION

One of the serious complications of long-standing Type 2 diabetes is diabetic neuropathy, the result of decreased neuronal activity. One such debilitating effect of neuropathy is cognitive decline. In the present study, HbA1c levels were less in the test group than the controls. There are studies available where HbA1c were decreased in diabetes,[10,11] In Type 2 diabetic patients, increased brain glucose levels were observed[12] that alter the brain metabolites and may impair cognitive function. In our study, HbA1c levels were less in the test group than in the controls because yogasanas and pranayama normalized the increased plasma glucose levels by increasing the peripheral uptake of glucose or by increasing the pancreatic insulin secretion. In the control group, the mean HbA1c levels are higher than the test group, and these high levels may increase the brain glucose and increased brain glucose levels alters the brain metabolite levels such as N-acetyl aspartate, glutamate, and glutamine.[13] Altered brain metabolite levels would alter the cognitive abilities.[14] In Type 2 diabetes, brain metabolites are altered and thus resulting in cognitive decline,[15] and this cognitive decline can be ameliorated with yogasanas and pranayama.[16] Normal glucose levels will stabilize the brain metabolites near normal levels and decreases the production of advanced glycosylated end products. ACE-R scores were significantly more in the test group than the control group, and this can be attributed to the high HbA1c levels in the control group. These findings clearly emphasize that yogasanas and pranayama has a positive effect on overall cognitive performance in Type 2 diabetes patients (Table 4).[10] Memory, language, visuospatial, and attention/orientation domain scores were also better individually in test group than in controls. As ACE-R is sensitive to mild cognitive impairment,[8] it can also be used in diseases where cognition is affected such as Parkinson's, frontotemporal dementia, and Alzheimer's.[17,18] Further studies are required to analyze the verbal fluency

scores in detail. In future, we look forward to find the relation among plasma HbA1c levels, brain metabolites, and cognitive function. For this, we are determined to estimate the brain metabolite levels in particular their ratios using highly sophisticated methods such as proton magnetic resonance spectroscopy.

Limitations

Difficult to measure the number of hypo/hyperglycemic attacks/day in the patients, as these attacks can have a role in pathophysiology cognitive decline in Type 2 diabetes.

Quantitative analysis of stress was not done. Before, the commencement of yogasanas and pranayama we did not measure cognition. Selecting the patients from the same locality does not guarantee same cultural, socioeconomical, or educational status. Participants were not randomly allocated to test and control groups.

CONCLUSION

Designed yogasanas and pranayama in the present study have restricted the cognitive decline in Type 2 diabetic patients, and therefore, this study advises all the Type 2 diabetic patients should undertake the yogasanas and pranayama as their daily routine.

ACKNOWLEDGMENT

Research reported in this publication was conducted by scholars at the Fogarty International Center of the NIH training program under Award Number D43 TW 009078. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Health.

REFERENCES

1. World Health Organization, Diabetes Fact Sheet No. 312; 2011. Available from: http://www.dwatch.spikar.gr/who-key-facts-about-diabetes-mellitus-october-2013. [Last accessed on 2015 Feb 26].
2. International Diabetes Federation. Available from: http://www.idf.org/diabetesatlas/update-2014. [Last retrieved on 2014 Nov 29].
3. Santhakumari R, Reddy IY, Archana R. Effect of Type 2 diabetes mellitus on brain metabolites by using proton magnetic resonance spectroscopy-A systematic review. Int J Pharma Bio Sci. 2014;5(4):1118-23.
4. Kandel ER, Schwartz JM, Jessell JM, editors. Essentials of Neural Science and Behavior. Norwalk, CT: Appleton & Lange; 1995. p. 319.
5. Cukierman TN, Gerstein HC, Williamson JD. Cognitive decline and dementia in diabetes--systematic overview of prospective observational studies. Diabetologia. 2005;48(12):2460-9.
6. Patel C, North WR. Randomised controlled trial of yoga and bio-feedback in management of hypertension. Lancet. 1975;2(7925):93-5.
7. Rugmini PS, Sinha RN. The Effect of Yoga Therapy in Diabetes Mellitus. Seminar on Yoga Man and Science, Delhi India. New Delhi: Yoga Research Hospital, Vishwayatan Yogashram, CCRIMH; 1976. p. 175-89.
8. Mioshi E, Dawson K, Mitchell J, Arnold R, Hodges JR. The Addenbrooke's cognitive examination revised (ACE-R): A brief cognitive test battery for dementia screening. Int J Geriatr Psychiatry. 2006;21(11):1078-85.
9. Mathuranath PS, Hodges JR, Mathew R, Cherian PJ, George A, Bak TH. Adaptation of the ACE for a Malayalam speaking population in southern India. Int J Geriatr Psychiatry. 2004;19(12):1188-94.
10. Kyizom T, Singh S, Singh KP, Tandon OP, Kumar R. Effect of pranayama & yoga-asana on cognitive brain functions in Type 2 diabetes-P3 event related evoked potential (ERP). Indian J Med Res. 2010;131:636-40.
11. Sahay BK. Role of yoga in diabetes. J Assoc Physicians India. 2007;55:121-6.
12. Sinha S, Ekka M, Sharma U, Raghunandan P, Pandey RM, Jagannathan NR. Assessment of changes in brain metabolites in Indian patients with Type-2 diabetes mellitus using proton magnetic resonance spectroscopy. BMC Res Notes. 2014;7:41.
13. Malhotra V, Singh S, Sharma SB, Gupta P, Prasad A, Tandon OP, et al. The status of NIDDM patients after yoga asanas: Assessment of important parameters. J Clin Diagn Res. 2010;4:2652-67. Available from: http://www.jcdr.net/back_issues.asp?issn=0973-709x&year=2010 &month= June &volume=4& issue=3&page=2652-2667 &id=1048. [Last cited on 2010 Jun 30].
14. Ferguson KJ, MacLullich AM, Marshall I, Deary IJ, Starr JM, Seckl JR, et al. Magnetic resonance spectroscopy and cognitive function in healthy elderly men. Brain. 2002;125:2743-9.
15. Nagothu RS, Reddy YI, Rajagopalan A, Varma R. Right dorsolateral frontal lobe N-acetyl aspartate and myoinositol concentration estimation in Type 2 diabetes with magnetic resonance spectroscopy. J Clin Diagn Res. 2015;9(7):16-9.
16. Santhakumari R, Indla YR, Kumar S, Archana R. Study of cognition in Type 2 diabetes with yoga asana and pranayama. RJPBCS. 2013;3(2):1637-41.
17. Bak TH, Rogers TT, Crawford LM, Hearn VC, Mathuranath PS, Hodges JR. Cognitive bedside assessment in atypical parkinsonian syndromes. J Neurol Neurosurg Psychiatry. 2005;76(3):420-2.
18. Mathuranath PS, Nestor PJ, Berrios GE, Rakowicz W, Hodges JR. A brief cognitive test battery to differentiate Alzheimer's disease and frontotemporal dementia. Neurology. 2000;55(11):1613-20.

How to cite this article: Nagothu RS, Rajagopalan A, Indla YR, Paluru R. Beneficial effects of yogasanas and pranayama in limiting the cognitive decline in Type 2 diabetes. Natl J Physiol Pharm Pharmacol 2017;7(3):232-235.

Source of Support: Nil, **Conflict of Interest:** None declared.