

EFFECT OF YOGA ON AVERAGE GLUCOSE LEVEL (HbA1C) IN TYPE 2 DIABETES AND PRE-DIABETES IN URBAN KARNATAKA

Dissertation submitted by

SANCHI VAID

Towards the partial fulfillment of

MASTER OF SCIENCE IN YOGA THERAPY

JUNE 2018



SWAMI VIVEKANANDA YOGA ANUSANDHANA SAMSTHANA

(Declared as Deemed University under Section 3 of the UGC Act, 1956)

BENGALURU - 560 019

INDIA

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Under the Guidance of

Sri Padmasri Gudapti



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CERTIFICATE

This is to certify that SANCHI VAID is Submitting this Experimental Research **EFFECT OF YOGA ON AVERAGE GLUCOSE LEVEL (HbA1C) IN TYPE 2 DIABETES AND PRE-DIABETES IN URBAN KARNATAKA**, in partial fulfillment of the requirement for the Master of Science Yoga Therapy on June 2018 by the SWAMI VIVEKANADA YOGA ANUSANDHAN SAMSTHANA (S-VYASA UNIVERSITY) BENGALURU and this is a record of the work carried out by her in this institute.

GUIDE

SRI PADMASRI

D E C L A R A T I O N

I, hereby declare that this study was conducted by me at Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA), Bangalore, under the guidance of Sri Padmasri Gudapti, S-VYASA University Bangalore.

I also declare that the subject matter of my dissertation entitled “**EFFECT OF YOGA ON AVERAGE GLUCOSE LEVEL (HbA1C) IN TYPE 2 DIABETES AND PRE-DIABETES IN URBAN KARNATAKA**” has not previously formed the basis of the award of any degree, diploma, associate-ship, fellowship or similar titles.

Date:

Sanchi Vaid

Place: Bangalore

(Candidate)

ACKNOWLEDGEMENT

I would like to express my deepest gratitude to my guide, Sri Padmasri Gudapti for her guidance and encouragement. I am unable to express her contribution to my development through words.

I thank all the members of the faculty, for their help at different stages of this work. Also, I would like to thank all the participants involved in my research as subjects.

I will be always grateful to my university Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA) for its support in promoting my career.

I am indebted to my parents for their inspiration, love, and support.

Finally, I thank that unseen Divine without whose wish, this work wouldn't have been possible.

Date:

Place: Bangalore

Sanchi Vaid

STANDARD INTERNATIONAL TRANSLITERATION CODE USED TO TRANSLITERATE SANSKRIT WORDS

a	=	अ	ña	=	ढ	pa	=	प
ā	=	आ	ca	=	च	pha	=	फ
i	=	इ	cha	=	छ	ba	=	ब
ī	=	ई	ja	=	ज	bha	=	भ
u	=	उ	jha	=	झ	ma	=	म
ū	=	ऊ	ñ	=	ञ	ya	=	य
ṛ	=	ऋ	ṭa	=	ट	ra	=	र
ṝ	=	ॠ	ṭha	=	ठ	la	=	ल
e	=	ए	ḍa	=	ड	va	=	व
ai	=	ऐ	ḍha	=	ढ	śa	=	श
o	=	ओ	ṇa	=	ण	ṣa	=	ष
au	=	औ	ta	=	त	sa	=	स
ṁ	=	अं	tha	=	थ	ha	=	ह
ḥ	=	अः	da	=	द	kṣa	=	क्ष
ka	=	क	dha	=	ध	tra	=	त्र
kha	=	ख	na	=	न	jña	=	ज्ञ
ga	=	ग						
gha	=	घ						

Abstract

Aim:

The aim of this study is to observe the effect of IAYT on HbA1c in TYPE 2 diabetes and pre-diabetes patients and its prevalence in an urban area of Karnataka.

Settings and Design:

This is a one arm Pre-Post Design comprised of 19 diabetes and pre-diabetes patients (Male-10, Female-9). Participant's age are ranged from 35 to 60 years. Subjects are taken from JIGANI, Anekal, Bangalore, Karnataka, India.

Methods and Material:

Yoga practice is given to the pre-diabetic and diabetic participants who agreed to participate in the study for 3 months, 6 days in a week for 1 hour. Yoga module consists of asana, pranayama meditation and relaxation technique. The yoga practice module which is placed in Appendix has been prepared by AYUSH MANTRALAYAM, INDIA.

Results:

Glycated hemoglobin (HbA1c) showed a significant reduction ($p < 0.05$) from 7.89 ± 2.01 to 7.51 ± 1.88 . The effect size is 0.1 with 4.8% changes.

Conclusions:

The current study showed a statistically significant reduction in glycated hemoglobin (HbA1c) after the yoga intervention in persons with Diabetes and Pre-Diabetes. Yoga module developed by AYUSH MANTRALAYA helps to reduce or control HbA1c in Diabetic and Pre-Diabetic people by practicing for one hour daily on weekdays 3 months.

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INTRODUCTION

Diabetes Mellitus is a most common chronic non-communicable disease and it affects more than 150 million people worldwide(Mohan, Singh, Khattar, Singh, & Shankar, 2015); Indian 52% mortality is affected by non- communicable diseases along with diabetes(Subramanian, 2016). According to WHO, worldwide 366 million people have diabetes in 2011 & in 2030 number may rise to 552 approximately(Ghosh, 2015).

According to American Diabetes Association, diagnosis of diabetes require biochemical criteria is- HbA1c value of 6.5% or higher, and FPG>126 mg/dl(7.0 mmol/l), 2-hoursPG>200 mg/dl(11.1mmol/l)(Sciences, 2011).Diabetes is a complex metabolic syndrome with an absolute deficiency or inefficiency of insulin(Pa &Varne, 2017a). According to American Diabetes Association and the World Health Organization-Primary diagnostic for the presence of diabetes fasting plasma glucose level of 126mg/dl and a random glucose measurement of over 200 mg/dl and associated by symptoms is also diagnostic(Kligler & Lynch, 2003).

Classification of DM

The ancient Indian Physicians categorized diabetes into two groups – obese and lean(Sahay, 2007). Diabetes mellitus is a disorder characterized by an inability to properly transport and metabolize glucose. Type-I diabetes known as juvenile onset or insulin-dependent, is caused by a failure of insulin production in the pancreas. Type-II diabetes called non-insulin-dependent; the problem is insulin resistance & decreased the sensitivity of the insulin receptor. Type-III diabetes is gestational diabetes, which is occurring during pregnancy(Kligler & Lynch, 2003).

Causes

Diabetes Mellitus is mainly produced by variations in lifestyle, habits, lack of exercise, tension, addictions like smoke & alcoholism etc.(Bidada, Usha, & Harshitha, 2016).

Symptoms

Diabetes symptoms are polyuria, polydipsia, and unexplained weight loss(Sciences, 2011).

COMPLICATION OF DIABETES:

Complications of Diabetes Mellitus are cardiovascular disease, peripheral vascular disease, retinopathy, nephropathy and loss of physical function (Sciences, 2011).

Prevalence:

According to World Health Organization (WHO), recent research for the global prevalence of diabetes stated that India, China & USA having a highest diabetic population in the world. The urban population in developing countries is projected multiple in the time of 2000 to 2030; estimated prevalence will be more in urban area (Bidada et al., 2016); diabetes prevalence is growing rapidly worldwide and reaching epidemic proportions (Subramanian, 2016); It is predicted that adult prevalence will rise 7.7% worldwide in 2015; a total of 95% population presents with Type-II DM (Kamani, Singh, & Nagoria, 2017). According to the National Urban Survey the prevalence in the southern part of India to be higher compared to another part of India (Sciences, 2011).

Measurement

Participants were asked to finish their dinner before 8pm on the earlier night and not to eat anything more. They were requested to go ahead with their medication as usual. Next day morning on empty stomach at 8am blood samples was collected for FBS and HbA1c. Breakfast was given and 2hrs after breakfast, once again blood samples were taken for PPBS

Yoga & DM

In ancient India yoga was followed as a way of life, which includes changes in mental attitude, diet, and the practice of Asanas, pranayama, and meditation (Ghosh, 2015); regular exercise improves insulin sensitivity and blood glucose uptake in subjects with diabetes (Pa & Varne, 2017a). There was a significant reduction in diabetes in fasting and post-prandial blood sugar level, after the intervention of three-month yoga and pranayama (Ghosh, 2015). Yoga helps to reduce weight, improve blood supply to various muscles and reducing stress hormones by improving the release of insulin from the pancreas (Maninder, Seema, & Shema, 2013). Pre-

diabetes, modest amounts of weight loss and regular physical activity are much more effective in preventing or delaying the onset of type 2 diabetes(Kamani et al., 2017).The ancient Indian physicians, Sushruth and Charaka had a good knowledge about diabetes,the importance of diet and exercise in the management of diabetes(Sahay, 2007).

Yoga is an ancient tradition, Indian psychological, a physical and spiritual exercise that has been studied for the management of several chronic epidemic diseases. In diabetes, various yoga asana breathing exercise, meditation, and relaxation may be directly rejuvenated cells of the pancreas as a result of which there may be an increase in utilization and metabolism of glucose in the peripheral tissues, liver, and adipose tissues through enzymatic processes. Aljasir, Bryson, and Al-Sheri (2010) and Innes and Vincent (2007) in there systematic reviews on yoga-based program on management of DM 2 adults concluded there is growing evidence that yoga practice may aid in the prevention and management of DM 2, reduce IRS-related risk factors associated with DM 2(Vaishali, Kumar, Adhikari, & UnniKrishnan, 2012).

LITERATURE REVIEW

All the slokas related to vyayama from the following scriptures have been placed in the dissertation

Scriptures

Sushruth samhita

Charaka samhita

Astanga hrdayam

Astanga Sangraha

Hath yoga Pradipika

CONCEPT OF VYAYAMA ACCORDING TO ANCIENT TEXT

MEANING OF EXERCISE ACCORDING TO SHUSRUTHA SAMHITA

शरीरायासजननंकर्म व्यायामसंज्ञितम् ॥

तत् कृत्वा तु सुखं देहं विमृद्नीयात् समन्ततः ॥३८॥

śarīrāyāsajananaṁ karma vyāyāmasañjñitam ॥

tat kṛtvā tu sukhaṁ dehaṁ vimṛdnīyāt samantataḥ ॥38॥

SU. NI.Vol II-38

Meaning:-The work involving exertion of the body is termed as (vyāyāma) physical exercise. After doing it one should press the body gently all over.

Benefits:-

शरीरोपचयः कान्तिर्गात्राणां सुविभक्तता ॥

दीप्तान्निवमनालस्यं स्थिरत्वं लाघवं मृजा ॥३९ ॥

śarīropacayaḥ kāntirgātrāṇām suvibhaktatā ॥

dīptāgnitvamanālasyaṁ sthīratvaṁ lāghavaṁ mṛjā ॥39॥

SU. NI.Vol II-39

Meaning:-Physical exercise causes physical development, luster, compactness of body parts, stimulation of digestive power, the absence of idleness, firmness, lightness, cleanliness, tolerance to fatigue, exhaustion, thirst, heat, cold etc and it provides optimum immunity.

वयोरूपगुणैर्हीनमपि कुर्यात् सुदर्शनम् ॥

व्यायामं कुर्वतो नित्यं विरुद्धमपि भोजनम् ॥४४ ॥

vayorūpaḡaṇairhīnamapi kuryāt sudarśanam ॥

vyāyāmaṁ kurvato nityaṁ viruddhamapi bhojanam ॥44॥

SU. NI.Vol II-44

Meaning:-Even incompatible food, cooked or uncooked is digested without any difficulty in persons performing exercise daily.

बलस्यार्धेन कर्तव्यो व्यायामो हन्त्यतोऽन्यथा ॥

हृदि स्थानस्थितो वायुर्यदा वक्त्रं प्रपद्यते ॥४७ ॥

balasyārdhena kartavyo vyāyāmo hantyaतो'nyathā ॥

hṛdi sthānasthīto vāyuryadā vaktraṁ prapadyate ॥47॥

SU. NI.Vol II-47

Meaning:-When (prana) vayu situated in heart comes out to mouth while performing exercise. (singn of balardha, i.eit issign of the half of strength.

समीक्ष्य कुर्याद् व्यायाममन्यथा रोगमाप्नुयात् ॥

क्षयतृष्णारुचिच्छर्दि रक्तपित्तभ्रमक्लमाः ॥४९॥

samīkṣya kuryād vyāyāmamanyathā rogamāpnuyāt ॥

kṣayastr̥ṣṇārucicchardiraktapittabhramaklamāḥ ॥49॥

SU. NI.Vol II-49

Meaning: Wasting, thirst, anorexia, vomiting, intrinsic, haemorrhage, giddiness, exhaustion, cough, consumption, fever and dyspnoea. (i.e complication of excess exercise).

MEANING OF EXERCISE ACCORDING TO CHARAKA SAMHITA

लाघवं कर्मसामर्थ्यं स्थैर्यं दुःखसहिष्णुता ॥

दोषक्षयोऽग्निवृद्धिश्च व्यायामादुपजायते ॥३२॥

lāghavaṁ karmasāmarthyam sthairyam duḥkhasahiṣṇutā ॥

doṣakṣayo'gnivṛddhiśca vyāyāmādupajāyate ॥32॥

CH. NI.Vol 1-32

Meaning: -Physical exercise brings about lightness, ability to work, stability, resistance to discomfort and alleviation of dosas (specially kapha). It stimulates the power of digestion.

श्रमः क्लमः क्षयस्तृष्णा रक्तपित्तं प्रतामकः ॥

अतिव्यायामतः कासो ज्वरश्छर्दिश्च जायते ॥३३॥

śramaḥ klamaḥ kṣayastr̥ṣṇā raktapittaṁ pratāmakaḥ ॥

ativyāyāmataḥ kāso jvaraśchardīśca jāyate ॥33॥

CH. NI.Vol 1-33

Meaning: a -Physical exercise in the excess cause of exertion, exhaustion, consumption, thirst, bleeding from different part of the body (raktapitta) pratāmaka (a type of dyspnoea) a cough, fever, and vomiting.

अतिव्यवायभाराध्वकर्मभिश्चातिकर्षिताः ।

क्रोधशोकभयायासैः क्रान्ता ये चापि मानवाः ॥१॥

ativyavāyabhārādhvakarmabhiścātikarśitāḥ ।

krodhaśokabhayāyāsaiḥ krāntā ye cāpi mānavāḥ ॥1॥

बालवृद्धप्रवाताश्च ये चोच्चैर्बहुभाषकाः ।

ते वर्जयैयुर्व्यायामं क्षुधितास्तृषिताश्च ये ॥२॥

bālavṛddhapravātāśca ye coccairbahubhāṣakāḥ ।

te varjayeyurvyāyāmaṁ kṣudhitāstrṣitāśca ye ॥2॥

CH. NI.Vol 1-1,2

Meaning: Exercise is contraindicated due to excessive sexual activity, weightlifting and by traveling on foot and for those who are in grip of anger, grief, fear, exhaustion and for the children, for the old persons and person having vātika constitution and profession of speaking too much. one should not do exercise while he is hungry and thirsty.

क्रमेणापचिता दोषाः क्रमेणोपचिता गुणाः ।

सन्तो यान्त्यपुनर्भावमप्रकम्प्या भवन्ति च ॥३८॥

krameṇāpacitā doṣāḥ krameṇopacitā guṇāḥ ।

santo yāntyapunarbhāvamaprakampyā bhavanti ca ॥38॥

CH. NI.Vol 1-38

Meaning:-By slowly and gradually giving up the unwholesome practices and by increasing the wholesome practices correspondingly the unwholesome practices are eradicated forever and the wholesome practices are fully adopted.

One should not be in hurry to give up and to adopt the unwholesome and wholesome practices respectively. A sudden change in habits is likely to cause immune harm to the body of (Astanga hrudaya:sutra 3:58) Only a slow and steady process as indicated in the text above can absolutely eradicate the effects of unwholesome practices and stabilize the effects of wholesome ones.

EXERCISE ACCORDING TO ASHTANGAHRDAYAM

लाघवं कर्मसामर्थ्यं दीप्तोऽग्निर्मेदसः क्षयः ॥

विभक्तघनगात्रत्वं व्यायामादुपजायते ॥१० ॥

lāghavaṁ karmasāmarthyam dīpto'gnirmedasaḥ kṣayaḥ ॥

vibhaktaghanagātratvaṁ vyāyāmādupajāyate ॥10॥

AH Vol 1-10

Meaning:-Lightness [of the body],ability to do[hard] work,keen digestion,depletion of[excess] fat,stable and distinct physique,accure from vyāyāmā[physical exercise].

वातपित्तामयी बालो वृद्धोऽजीर्णा च तं त्यजेत् ।

अर्धशक्त्या निषेव्यस्तु बलिभिः स्निग्धभोजिभिः ॥११ ॥

शीतकाले वसन्ते च मन्दमेव ततोऽन्यदा ।

vātapittāmayī bālo vṛddho'jīrṇā ca taṁ tyajet ॥

ardhaśaktyā niṣevyastu balibhiḥ snigdhabhojibhiḥ ॥11॥

śītakāle vasante ca mandameva tato'nyadā ॥

AH Vol 1-11

Meaning:-Person who are strong and who indulge in fatty foods [daily];inthe cold season and in spring [season] should do it.[exercise] to half of their strength [capacity] only; while others [and in another season] should do it mildly.

Note:-Half of the capacity of the person is understood by the appearance of perspiration on his forehead,nose,axilla,joints of the limbs and feeling of dryness of the mouth.

तं कृत्वाऽनुसुखं देहं मर्दयेच्च समन्ततः ॥१२ ॥

taṁ kṛtvā'nusukhaṁ dehaṁ mardayeccha samantataḥ||12||

AH Vol 1-12

Meaning:-After doing it [exercise] all the parts of the body should be managed comfortably.

तृष्णा क्षयः प्रतमको रक्तपित्तं श्रमः क्लमः ।

अतिव्यायामतःकासो ज्वरश्छर्दिश्च जायते ॥१३ ॥

tr̥ṣṇā kṣayaḥ pratamako raktapittaṁ śramaḥ klamaḥ|

ativyāyāmataḥ kāso jvaraśchardīśca jāyate||13||

AH Vol 1-13

Meaning:-Thirst, emaciation,severe dyspnoea[difficult or excess breathing],bleeding diseases,exhaustion,feeling of debility [even without any work],cough,fever,and vomiting are caused by an excess of exercise.

EXERCISE ACCORDING TO ASTANGA SANGRAHA

शरीरायासजननं कर्म व्यायाम उच्यते ।

लाघवं कर्मसामर्थ्यं दीप्तोऽग्निर्मेदसः क्षयः ॥६२ ॥

śarīrayāśajananaṁ karma vyāyāma ucyate|

lāghavaṁ karmasāmarthyam dīpto'gnirmedasaḥ kṣayaḥ||62||

AS-62

Meaning:-Activities which produce tiredness to the body is known as vyāyāma[exercise]

Advantages of exercise:-

Body becomes light. Able to perform normal duties with enthusiasm. Reduces the fat and body parts become distinct and firm.

तृष्णा क्षयः प्रतमको रक्तपित्तं श्रमः क्लमः ।

अतिव्यायामतःकासो ज्वरश्च्छर्दिश्च जायते ॥६५ ॥

tr̥ṣṇā kṣayaḥ pratamako raktapittaṁ śramaḥ klamaḥ ।

ativyāyāmataḥ kāso jvaraścchardīśca jāyate ॥65॥

AS-65

Meaning: Excessive, exercises, leads, to, following, complication like, thirst, emaciation, dyspnoea, haemorrhage, exhaustion, tiredness, cough, fever, vomitings etc

व्यायामजागराध्वस्त्रीहास्यभाष्यादिसाहसम् ।

गजं सिंह इवाऽकर्षन् भजन्नति विनश्यति ॥६६ ॥

vyāyāmajāgarādhvastrīhāsyabhāṣyādisāhasam ।

gajaṁ siṁha ivā'karṣan bhajannati vinaśyati ॥66॥

AS-66

Meaning:- Due to excessive exercise, not sleeping in the night, walking a long distance, excessive coitus, too much talking and laughing, acts of exertion etc, will destroy the body as a lion fights with an elephant and dies.

EXERCISE ACCORDING TO HATHA YOGA PRADIPIKA

MTSYENDRASANA (Spinal twist pose)

वामोरुमूलार्पितदक्षपादं जानोर्बाहिर्वेष्टितवामपादम् ।

प्रगृह्य तिष्ठेत्परिवर्तितांगः श्रीमत्स्यनाथोदितमासनं स्यात् ॥२६ ॥

vāmorumūlārpitadakṣapādaṃ jānorbahirveṣṭitavāmapādam |

praḡhya tiṣṭhetparivartitāṅgaḥ śrīamatsyanāthoditamāsanam syāt ||26

HYP/CH-1/26(Svatmarama, 1893)

Meaning:Place the right foot at the base of the left thigh, the left foot at the side of the right knee. Take hold of the left foot with the right hand, pass the left arm behind the waist and remain with the body turned. This asana is described by Sri Matsyendranath.

PASCHIMOTTANASANA (Back stretching pose)

प्रसार्य पादौ भुवि दंडरूपौ दोभ्यां पदाग्रद्वितयं गृहीत्वा ।

जानूपरिन्यस्तललाटदेशो वसेदिदं पश्चिमतानमाहुः ॥२८ ॥

prasārya pādau bhuvi daṇḍarupoo dorbhyāṃ padāgradvitayaṃ gṛhītvā |

jānūparinyastalalāṭadeśo vasedidaṃ paścimatānamāhuḥ ||28||

HYP/CH-1/25(Svatmarama, 1893)

Meaning: Stretching the legs (in front) on the ground, like a stick; bending forward, holding the toes with both hands and placing the forehead on the knees, is called Paschimatanasana.

MAYURASANA (Peacock Pose)

धरामवष्टभ्य करद्वयेन तत्कूर्परस्थापितनाभिपार्श्वः ।

उच्चासनो दंडवदुत्थितःखे मायूरमेतत्प्रवदन्ति पीठम् ।३० ॥

dharāmavaṣṭabhya karadvayeina tatkūrparasthāpitanābhipāśvaḥ |

uccāsanoo daṇḍavadutthitaḥ khe māyūrametatpravadanti pīṭham |30||

HYP/CH-1/30 (Svatmarama, 1893)

Meaning:Lie on the stomach, placing both hands on the ground and the elbows at the sides of the navel. Raise the body high, keeping it like a stick. This is called the peacock pose by the exponents of yoga.

DHANURASANA (Bow pose)

पादाङ्गुष्ठौ तु पाणिभ्यां गृहीत्वा श्रवणावधि ।

घनुराकर्षणं कुर्याद्धनुरासनमुच्यते ॥२५॥

pādāṅguṣṭhau tu paṇibhyāṃ gr̥hītvā śravaṇāvadhī

ghanurākaraṣaṇaṃ kuryādghanurāsanamucyate ॥25॥

HYP/CH-1/25(Svatmarama, 1893)

Meaning: Holding the toes with the hands, pull them up to the ears as if drawings a bow' this is called Dhaurasana.

REVIEW OF THE SCIENTIFIC LITERATURE

DIABETES MELLITUS-EXERCISE

S.NO	AUTHOR	TITLE	PARTICIPANT	METHOD	RESULT	CONCLUSION
1.	(Pahra et al., 2017)	Impact of post-meal and one-time daily exercise in a patient with type 2 diabetes mellitus: a randomized crossover study.	N=64 T2DM (Group A n = 32, Group B n =32)	RCT	Both the groups A and B showed improvement when exercise is given after each meal rather than one-time exercise (even though the total period of exercise in both cases is equal i.e. 45min walking)	In T2DM patients the effect of exercise after the meal is more compared to daily exercise in reducing sugar levels.
2.	(Gordon et al., 2008)	Effect of exercise therapy on lipid profile and oxidative stress indicators in patients with type 2 diabetes.	N=231 T2DM, (186 females and 45 males).	RCT	Hath Yoga exercises, as well as Physiotherapy exercises practiced for 6 months, decreased oxidative stress.	Hath yoga exercise and conventional PT exercise may have therapeutic preventative and protective effects on DM by decreasing oxidative stress and improving antioxidant status.
3.	(Rajasekaran & Perumal, 2014)	Role of Vethathiri Maharishi's Kaya Kalpa Technique and Simplified Physical Exercise (Maharasana) in the Management of Type-2 Diabetes	N=15 , male=7, Female = 8	Single group	By the practice of Maharasana for 3 months, there was a significant decrease in FBS, PPBS, and HbA1c.	Yoga program could potentially be a reduction option for HbA1c on type 2 diabetes patients.

		Mellitus-A Pilot Trial.				
4.	(Gurudut & Rajan, 2017)	The immediate effect of passive static stretching versus resistance exercises on postprandial blood sugar levels in type 2 diabetes mellitus: a randomized clinical trial.	N=51 T2DM, (PSS n=25 and RE n=26)	RCT	PSS and RE showed an equal amount of reduction in Sugar levels on immediate effect of Exercise.	PSS and RE reduce PPBS in T2DM and can be prescribed for the patients who have difficulty in controlling postprandial spike.

Mr. Pahra in his study on Impact of post-meal and one-time daily exercise in a patient with type 2 diabetes mellitus: a randomized crossover study with 64 T2DM participants (Group A n = 32, Group B n =32) both the groups A&B showed improvement when exercise is given after each meal rather than one-time exercise. In T2DM patients the effect of exercise after the meal is more compared to daily exercise in reducing sugar levels. Mr. Gordon's in his study on Effect of exercise therapy on lipid profile and oxidative stress indicators in patients with type 2 diabetes with 231 T2DM participants, (186 females and 45 males) with randomized control trial. Hath yoga exercise, as well as physiotherapy exercises six months, decreased oxidative stress. Hath yoga exercise and conventional PT exercise may have therapeutic preventative and protective effects on DM by decreasing oxidative stress and improving antioxidant status. Mr.Rajasekaran in his study on Role of Vethathiri Maharishi's Kaya Kalpa Technique and Simplified Physical Exercise (Maharasana) in the Management of Type-2 Diabetes Mellitus-A Pilot Trial with 15 participants, (male=7, Female = 8) with the Single group, by practice Maharasana for 3 months there was a significant decrease in FBS, PPBS, and HbA1c. Yoga program could potentially be a reduction option for HbA1c on T2DM. Mr.Gurudut in his study on the Immediate effect of passive static stretching versus resistance exercises on postprandial blood sugar levels in type 2 diabetes mellitus: a randomized clinical trial with 51 T2DM participants, (PSS n=25 and RE n=26), PSS and RE showed an equal amount of reduction in sugar levels on

immediate effect of exercise. PSS and RE equal PPBS in T2DM and can be prescribed for the patients who have difficulty in controlling PPBS.

PRE-DIABETES MELLITUS

S.NO	AUTHOR	TITLE	PARTICIPANT	METHOD	RESULT	CONCLUSION
1.	(Keerthi et al., 2017)	Effect of 12 Weeks of Yoga Therapy on Quality of Life and Indian Diabetes Risk Score in Normotensive Indian Young Adult pre diabetics and Diabetics: Randomized Control Trial	N=310 DM (controls n=62, pre-diabetics n=124 and diabetics n=124)	RCT	Yoga group showed a significant reduction in QOL and IDRL compared to standard treatment alone in both diabetics and pre-diabetics	Yoga therapy along with standard treatment for 12 weeks improved QoL and attenuated the diabetes risk among Indian pre-diabetics and diabetics compared to standard treatment alone.
2.	(Kumar, 2017)	A yoga intervention for type 2 diabetes risk reduction: a pilot randomized controlled trial.	N=41 (yoga n = 21 and control n = 20)	RCT	The results showed reductions in SBP and DBP, total cholesterol, anxiety, and depression, negative affect and perceived stress in both the yoga intervention and walking control.	More reduction in weight and waist circumference in yoga group compared to the walking group Yoga offers a promising lifestyle intervention for decreasing weight-related T2DM.
3.	(Bhat, Deo, Mavathur, & Srinivasan, 2016)	Correlation of Electro photonic Imaging Parameters With Fasting Blood Sugar	N=102 (29 normal, 13 pre-diabetic, and 60 diabetics)	Two group (pre-post design)	In the case of pre-diabetics showed a significant relationship of FBS with	FBS correlates differently in the normal, pre-diabetic, and diabetic groups. In the pre diabetic

		in Normal, Pre-diabetics, and Diabetic Study Participants.			pancreas and right kidney. A significant relationship of FBS was found with area and form coefficient of the EPI gram in the normal participant. For diabetics, showed the significant relationship of FBS with immune organs, left kidney, area, intensity, and entropy of EPI grams.	group, correlation of FBS with EPI parameters pancreas and right kidney is noteworthy and in line with latest findings in medical research.
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Mrs. Keerthi in his study on Effect of 12 Weeks of Yoga Therapy on QoL and Indian Diabetes Risk Score in Normotensive Indian Young Adult Prediabetics and Diabetics which is a randomized control trial with 310 DM subject (controls-62, pre-diabetics-124 and diabetics-124), showed significant reduction in QoL scale and IDRS compared to standard treatment in both diabetics and pre-diabetics. After 12 weeks of yoga therapy intervention improved QOL and outspent the diabetics and pre-diabetics compared to standard treatment alone. Mr. Kumar in his study on yoga intervention for type-II diabetes risk reduction, a pilot randomized controlled trial with a sample size of 41 (Yoga-21 and Control-20) showed a reduction in SBP & DBP, total cholesterol, anxiety, depression, negative affect and perceived stress in both yoga and control after the intervention. Yoga group reduced weight and waist circumference significantly. Mr. Bhat has done a correlation study on Electro Photonic Imaging Parameters with FBS in Normal, Pre-diabetes and Diabetes, with 102 participants, with two group pre-post design. This study showed the significant relationships of FBS with Pancreas and right kidney on pre-diabetes, the

relationship of FBS found form coefficient of the EPI on normal participants, and the relationship of FBS with immune organs, left kidney, intensity, and entropy of EPI grams on diabetes participants.

DIABETES MELLITUS- WALKING

S.NO	AUTHOR	TITLE	PARTICIPANT	METHOD	RESULT	CONCLUSION
1.	(Sharma, 2013)	Effects of Nordic walking and exercise in type 2 diabetes mellitus: a randomized controlled trial.	N=68 T2DM (37-Men, 31-Women)	RCT	There was no difference in HbA1c when comparing the intervention groups relative to the control group. No significant changes in other variables.	The finding of this study shows that there is no significant improvement in HbA1c in patients with type 2 diabetes after four-month exercise programs at a moderate intensity of either Nordic walking or Exercise.
2.	(Pa & Varne, 2017b)	Physiological effects of brisk walking, yoga, and non-Walking on metabolic parameters and anthropometry among type 2 diabetic patients.	N=120, 45 agreed for brisk walking, 40 agreed for non-walking and 35 agreed for yoga practice.	RCT	Both exercises had beneficial effects in improving the metabolic parameters like FBS, PPBS, HbA1c, TC, Triglycerides, HDL, LDL and also improving the anthropometric measurements weight, waist-hip ratio, waist circumference.	Both practices have significant physiological benefits in improving the metabolic parameters and anthropometric measurement among T2DM patients

Mr. Sharma in his study on Effects of Nordic walking and exercises in type 2 diabetes mellitus: randomized controlled trial WITH 68 T2DM participants. It is divided into 2 groups (37-Men, 31-Women) with randomized control trial. There was no difference in HbA1c when comparing the intervention groups relative to the control group. The study shows there is no significant improvement in HbA1c in patients with T2DM after four months exercise programs at a moderate intensity of either Nordic walking or exercise. Mr. Varne's in his study on Physiological effects of brisk walking, yoga, and non-Walking on metabolic parameters and anthropometry among type 2 diabetic patients took 120 T2DM participants. It is divided into 3 groups (45 agreed for brisk walking, 40 agreed for non-walking and 35 agreed for yoga practice). Both exercises had beneficial effects in improving the metabolic parameters like FBS, PPBS, HbA1c, TC, Triglycerides, HDL, and LDL. All parameters are improved. Showed significant physiological benefits in improving the metabolic parameters and anthropometric measurement among T2DM patients.

NOTE: - Nordic Walking is a sport or activity that involves walking across country with the aid of long poles resembling ski sticks.

DIABETES MELLITUS-AEROBIC

S.NO	AUTHOR	TITLE	PARTICIPANT	METHOD	RESULT	CONCLUSION
1.	(Suseelal et al., 2016)	A Study to Assess the Effectiveness of Home-Based Aerobic Training, Muscle Strengthening and Stretching Exercise on Self-Management Among Individuals with Diabetes Mellitus (DM) at Selected Villages in Kancheepuram	N= 400 (200 study + 200 Control)	Single blinded true experimental study.	Improvement in exercise pattern, HbA1c, and WHR among DM patients	Community-based care is the ideal one to develop a specific intervention, to manage DM.

		District, Tamil Nadu.				
2.	(Sigal et al., 2007)	Effects of Aerobic Training, Resistance Training, or Both on Glycemic Control of Type 2 Diabetes.	N=251 T2DM (Combined training =64, aerobic training=60, resistance training=64, control training=63)	RCT	Differ among groups. Adverse events were more common in the exercise groups.	Aerobic or resistance training alone improves glycaemic control in type 2 diabetes, but the improvements are greatest with combined aerobic and resistance training.

Mr. Suseelal in his study on A Study to Assess the Effectiveness of Home-Based Aerobic Training, Muscle Strengthening and Stretching Exercise on Self-Management Among Individuals with Diabetes Mellitus (DM) at Selected Villages in Kancheepuram District, Tamil Nadu with= 400participants (200 studies + 200 Control) with Single blinded true experimental study. Improvement in exercise pattern, HbA1c and WHR among DM patients. Community-based care is the ideal one to develop a specific intervention, to manage DM. Mr. Sigal in his study on Effects of Aerobic Training, Resistance Training, or Both on Glycemic Control in Type 2 Diabetes with 251 T2DM participants (Combined training =64, aerobic training=60, resistance training=64, control training=63)with randomized control trial. Differ among groups. Adverse events were more common in the exercise groups. Aerobic or resistance training alone improves Glycemic control in type 2 diabetes, but the improvements are greatest with combined aerobic and resistance training.

DIABETES MELLITUS-YOGA

S.NO	AUTHOR	TITLE	PARTICIPANT	METHOD	RESULT	CONCLUSION
1.	(Danaei et al., 2015)	Effect of Yoga on Anthropometric, Biochemical and	N=30 T2DM	RCT	Reduction in weight, BMI, and FBG.	The positive influence of yoga on The weight, glycaemic control and cognitive functions of T2DM

		Cognitive parameters in patients with Type 2 Diabetes Mellitus				patients.
2.	(Maninder et al., 2013)	INFLUENCE OF PRANAYAMAS AND YOGA-ASANAS ON BLOOD GLUCOSE, LIPID PROFILE AND HBA1C IN TYPE 2 DIABETES .	N=100T2DM without complications (aged 35 to 65 years) were divided into two groups. Group	Two group (pre-post) design	Improvement in all biochemical parameters except TG in group II patients while group I patients showed insignificant improvement.	The beneficial effect of yoga regimen on these parameters in diabetic patients.
3.	(Sahay, 2007)	Role of Yoga in Diabetes.	N=28 T2DM	Comparative studies	FBS and PPBS levels came down. Changes in the insulin kinetics and those of counter-regulatory hormones like cortisol.	Yogic practices are useful in all age groups and can be performed in all seasons and are useful for people who travel frequently.
4.	(Ghosh, 2015)	Effect of Yoga-Asana and Pranayama on Diabetic Adults.	N= 50 diabetic males (50 to 65)age range	pre-test and post-testdesign, RCT	Reduction in post-test condition. Yogic exercises showed a positive and significant impact on diabetic adults.	Yoga therapy improves the status of diabetics in terms of reduction of drug doses, physical and mental alertness and prevention of complications.
5.	(Muthuselvi,	Effect of Yoga on	N= 100 T2DM males (50-yoga	RCT	Reduction in the	Yoga can be practiced by

	Dhanalaks hmi, & Abhishek, 2017)	Glycosylate d hemoglobin levels in Diabetic subjects.	group, 50-control		Glycosylated hemoglobin levels in diabetic individuals practicing yoga.	diabetics as a measure of reducing the mortality due to diabetes.
6.	(Dash & Thakur, 2014)	EFFECT OF YOGA IN PATIENT' S WITH TYPE-II DIABETES MELLITUS .	N=120 T2DM	Two group (pre-post design)	The decrease in FBG, PPBG, HBA1C and lipid profile.	Yoga helps in decreasing blood sugar level and keep diabetes under control.
7.	(Vaishali et al., 2012)	Effects of Yoga-Based Program on Glycosylate d Haemoglobi n Level Serum Lipid Profile in Community -Dwelling Elderly Subjects with Chronic Type 2 Diabetes Mellitus–A Randomize d Controlled Trial.	N=57 T2DM	RCT	Improvement in HBA1C, FBS, and Lipid profile in Yoga group compared to the Educational group.	Yoga asana under supervision has beneficial effects on biochemical parameters for chronic T2DM.
8.	(Angadi et al., 2017)	Adherence to yoga and its resultant effects on blood glucose in Type 2	N=52 T2DM	Experimen tal design	Participants who completed the yoga program had significantly lower HbA1c	Yoga has an effect on the blood glucose parameters in diabetes. To motivate participants to undergo 'lifestyle modification

		diabetes: A community-based follow-up study.			(end of 3 months). Yoga practice for 6 months reduced FBS and Stress significantly	practices’.
9.	(Ebrahimi, Guilan-Nejad, & Pordanjani, 2017)	Effect of yoga and aerobic exercise on sleep quality in women with Type 2 diabetes: A randomized controlled trial.	N=39 women T2DM (yoga exercise (n=15), aerobic exercise (n=13), and control group (n=11).	RCT	Sleep quality improved after six weeks of yoga exercise. Also, a significant effect was observed after 6 weeks of aerobic exercise. However, the positive effect was diminished to under significant levels after 12 weeks of aerobic exercise.	The effect of Yoga exercise on improving the sleep quality is more than with the same course of aerobic exercise in women suffering from T2DM.
10.	(Chimkote, Kumaran, Kanhere, & Shivanna, 2015)	Effect of Yoga on Blood Glucose Levels in Patients with Type 2 Diabetes Mellitus	N=60 (30 male diabetic 30 non-diabetic male control group).	Two group (pre-post design)	The reduction in FBS and PPBS at the end of six months was highly significant in both the groups when compared with the mean values before and during (three months) yoga	The results showed that yoga is effective in reducing the blood glucose levels in patients with T2DM.

					practice. The reduction in these values at three months during yoga was highly significant in T2DM.	
11.	(Sreedevi, Gopalakrishnan, Karimassery Ramaiyer, & Kamalamma, 2017)	A Randomized controlled trial of the effect of yoga and peer support on glycaemic outcomes in women with type 2 diabetes Mellitus: a feasibility study.	N=124, DM (women each group 41)	RCT	A significant decrease was observed in diastolic blood pressure and hip circumference in the yoga group.	The effect of yoga and peer support on glycaemic outcomes was incremental. Longer-term studies are necessary to ascertain the benefits shown by this feasibility study.

Mr. Danaei in his study on Effect of Yoga on Anthropometric, Biochemical and Cognitive parameters in patients with Type 2 Diabetes Mellitus with 30 participants T2DM with randomized control trial, showed a reduction in weight, BMI, and FBG. The positive influence of yoga on the weight, Glycemic control and cognitive functions of T2DM patients. Mr. Maninder in his study on INFLUENCE OF PRANAYAMAS AND YOGA-ASANAS ON BLOOD GLUCOSE; LIPID PROFILE AND HBA1C IN TYPE 2 DIABETES with T2DM sample 100 without complications, age range was 35-60 years old, was divided in to two groups (pre-post) design showed improvement in all biochemical parameters except TG in group II patients while group, I patients showed insignificant improvement. The beneficial effect of yoga regimen on these parameters in diabetic's patients. Mr. Sahay in his study on Role of Yoga in Diabetes with 28 participants T2DM with Comparative studies showed that FBS and PPBS levels came down. There are Changes in the insulin kinetics. Yogic practices are useful in all age groups and can be performed in all seasons and are useful for people who travel frequently. Mr. Ghosh in his study

on Effect of Yogaasana and Pranayama on adult male diabetes participants, age group was 50-65 years, with pre-post design with randomized control trial, post data showed, yoga therapy improves the status of diabetics in terms of reduction of drug doses, physical and mental alertness and prevention of complications. Mr. Muthuselvi in his study on Effect of Yoga on Glycosylated hemoglobin levels in Diabetic type-II male with randomized control trial showed that there is reduction in the HbA1c level in yoga group. Mr. Dash in his study on EFFECT OF YOGA IN PATIENT'S WITH TYPE-II DIABETES MELLITUS with 120 T2DM participants with two groups, pre-post design, showed a decrease in FBG, PPBG, HBA1C and lipid profile. Yoga helps in decreasing blood sugar level and keeps diabetes in control. Mrs. Vaishali in her study on Effects of Yoga-Based Program on Glycosylated Hemoglobin Level Serum Lipid Profile in Community-Dwelling Elderly Subjects with Chronic Type 2 Diabetes Mellitus with the randomized controlled trial with T2DM participants 57, the study showed a change in HBA1C, FBS, and Lipid profile in Yoga group compared to the Educational group. Yoga asana have beneficial effects in biochemical parameters for chronic T2DM. Mr. Angadi study has proved on Adherence to yoga and its resultant effects on blood glucose in Type 2 diabetes: A community-based follow-up study with 52 participants with Experimental design showed participants completed yoga program had significantly lower HbA1c after 3 month of intervention, At the end of 6 months, found the significantly negatively correlated with FBS and stress. Yoga has an effect on the blood glucose parameters in diabetes. Mr. Ebrahimi in his study on Effect of yoga and aerobic exercise on sleep quality in women with Type 2 diabetes: A randomized controlled trial with 39 participants T2DM (yoga exercise (n=15), aerobic exercise (n=13), and control group (n=11) showed that yoga exercise improved sleep quality after 6 & 12 weeks. The effect of yoga exercise in improving the sleep quality is more in comparison with the same course of aerobic exercise in women suffering from T2DM. Mr. Chimkode in his study on Effect of Yoga on Blood Glucose Levels in Patients with Type 2 Diabetes Mellitus with 60 male participants (30 male diabetic 30 non-diabetic male control group) with two groups (pre-post design), showed a significant reduction in FBS and PPBS at the end of six months in both the groups. The result of this present study demonstrated that yoga can reduce blood glucose levels in T2DM patients. Mrs. Sreedevi in her study the effect of yoga and peer support on Glycemic outcomes in women with type 2 Diabetes Mellitus: a feasibility study with 124 participants on a randomized controlled trial, DM (women each group 41) showed that significant change found

in diastolic blood pressure and hip circumference in the yoga group. The effect of yoga and peer support on Glycemic outcomes was incremental. Longer-term studies are necessary to ascertain the benefits shown by this feasibility study.

OTHERS

DIABETES MELLITUS-YOGA, MUSIC						
S.NO	AUTHOR	TITLE	PARTICIPANT	METHOD	RESULT	CONCLUSION
1.	(Singh, Khandelwal, & Sherpa, 2015)	Effect of yoga and music therapy with standard diabetes care in Type II Diabetes Mellitus- A randomized control Study.	Out of 902 subjects, 112 were recruited in yoga, 110 in music and 115 in control group while others were excluded.	RCT	Yoga reducing anxiety and depression, reducing weight and BMI, and QOL. Motivation to engage in exercise-based programs.	T2DM without side effects and a self-administered program which may show promising effects in prevention and management.
DM-YOGA, AYURVEDA PANCHAKARMA						
S.NO	AUTHOR	TITLE	PARTICIPANT	METHOD	RESULT	CONCLUSION
1.	(Vaibhavi, Satyam, Sanjibkumar, Raghuram, & Ramarao, 2013)	Effect of Holistic Module of Yoga and Ayurvedic Panchakarma in Type 2 Diabetes Mellitus— A Pilot Study	N =12 T2DM (7-female , 5-male)	Experimental pilot study with a pre-post design.	After 6 months reduction in FBS, PPBS, HBA1C, Triglycerides, Total cholesterol. Baseline guna questionnaire showed six subjects each with rajas and tamas dominance.	This first pilot study has an indication of a potentially beneficial effect of combining traditionally recommended Ayurveda Panchakarma with maintenance herbs and Yoga, in reducing blood glucose and lipids.

DIABETES MELLITUS-NATUROPATHY						
S.NO	AUTHOR	TITLE	PARTICIPANT	METHOD	RESULT	CONCLUSION
1	(Nair, Saxena, Chawla, Sood, & Jain, 2013)	Effect of Two Months Naturopathy Treatment in Non-Insulin Dependent Diabetes Mellitus Patients.	N= 50 patients Intervention group = 32 naturopathy and allopathic medication with diet (control group) were on allopathic medication and diet control.	RCT	The result suggested significant changes in the levels of FBG and PPBG in both the groups and improvement was seen in Body Mass Index (BMI) only in group 1 patients.	All participants assigned to naturopathy expressed high satisfaction as they found the good change in the status of their T2DM.

DIABETES MELLITUS-CINNAMON						
S.NO	AUTHOR	TITLE	PARTICIPANT	METHOD	RESULT	CONCLUSION
1.	(Akilen, Tsiami, Devendra, & Robinson, 2010)	Glycated hemoglobin and blood pressure-lowering effect of cinnamon in multi-ethnic Type 2	N=58 type 2 diabetic patients (25 males and 33 females)	RCT	A reduction in FPG, waist circumference and BMI was observed at week 12 compared to baseline in the cinnamon group, however, the changes were not significant when compared to placebo	Intake of 2g of cinnamon for 12 weeks significantly reduces the HbA1c, SBP and DBP among poorly controlled T2DM patients

		diabetic patients in the UK: a randomized, placebo-controlled, double-blind clinical trial.			group.	
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DIABETES MELLITUS-LIFESTYLE						
S.NO	AUTHOR	TITLE	PARTICIPANT	METHOD	RESULT	CONCLUSION
1.	(Kamani et al., 2017)	“A STUDY OF LIFESTYLE INTERVENTIONS IN PATIENTS WITH TYPE2 DIABETES MELLITUS”	N=51 type 2 DM	RCT	Positive impact on BMI, HbA1c, SBP, DBP, HDL, and LDL.	The ideas that exercise is a cornerstone of diabetes therapy and findings of this study strongly support the ADA guidelines recommend that in the treatment regimen of T2DM.

Mr. Singh in his study on Effect of yoga and music therapy with standard diabetes care in Type II Diabetes Mellitus- A randomized control Study with 902 subjects, 112 were recruited in yoga, 110 in music and 115 in control group, while others were excluded, showed that Yoga reducing anxiety and depression, reducing weight and BMI and QOL. T2DM without side effects and a

self-administered program which may show promising effects in prevention and management. Mrs. Vaibhavi in her study on Effect of Holistic Module of Yoga and Ayurvedic Panchakarma in Type 2 Diabetes Mellitus—A Pilot Study with 12 participants T2DM (7-female, 5- male) with the Experimental pilot study (pre-post design).After 6 months reduction in FBS, PPBS, HBA1C, Triglycerides, Total cholesterol. This first pilot study has an indication of a potentially beneficial effect of combining traditionally recommended Ayurvedic Panchakarma with maintenance herbs and Yoga, in reducing blood glucose and lipids. Mr. Nair in his study on Effect of Two Months Naturopathy Treatment in Non-Insulin Dependent Diabetes Mellitus Patients with 50 patients Intervention group = 32 naturopathy and allopathic medication with diet (control group) were on allopathic medication and diet control with randomized control trial. The result suggested significant changes in the levels of FBG and PPBG in both the groups and improvement was seen in Body Mass Index (BMI) only in group 1 patients. All participants assigned to naturopathy expressed high satisfaction as they found the good change in the status of their T2DM. Mr. Akilen in his study on Glycated hemoglobin and blood pressure-lowering effect of cinnamon in multi-ethnic Type 2 diabetic patients in the UK: a randomized, placebo-controlled, double-blind clinical trial with 58 T2DM (25 males and 33 females), showed a reduction in FPG, waist circumference, and BMI in the cinnamon group. Mrs. Kamani in her study on “A STUDY OF LIFESTYLE INTERVENTIONS IN PATIENTS WITH TYPE2 DIABETES MELLITUS” with 51 participants T2DM with randomized control trial showed a positive impact on BMI, HbA1c, SBP, DBP, HDL,and LDL. This study strongly supports the ADA guidelines recommend that in the treatment regimen of T2DM.

AIM AND OBJECTIVES

AIM OF THE STUDY

This study is to observe the effect of IAYT on HbA1C in type 2 diabetes and pre-diabetes patients.

OBJECTIVES OF THE STUDY

The objectives of this study are to observe changes in HbA1C after the practice of IAYT

RESEARCH QUESTIONS

Will there be any change in HbA1c after 90 days of IATY practice?

HYPOTHESIS AND NUL HYPOTHESIS

HYPOTHESIS

There will be a change in HbA1C after the practice of IAYT for 3 months of IAYT practice.

NUL-HYPOTHESIS

There will be no change in HbA1C after the practice of IAYT for 3 months.

METHODS

PARTICIPANTS

Selection and source of subjects

Subjects are taken from JIGINI survey numbers 18 & 21, Anekal, Bangalore.

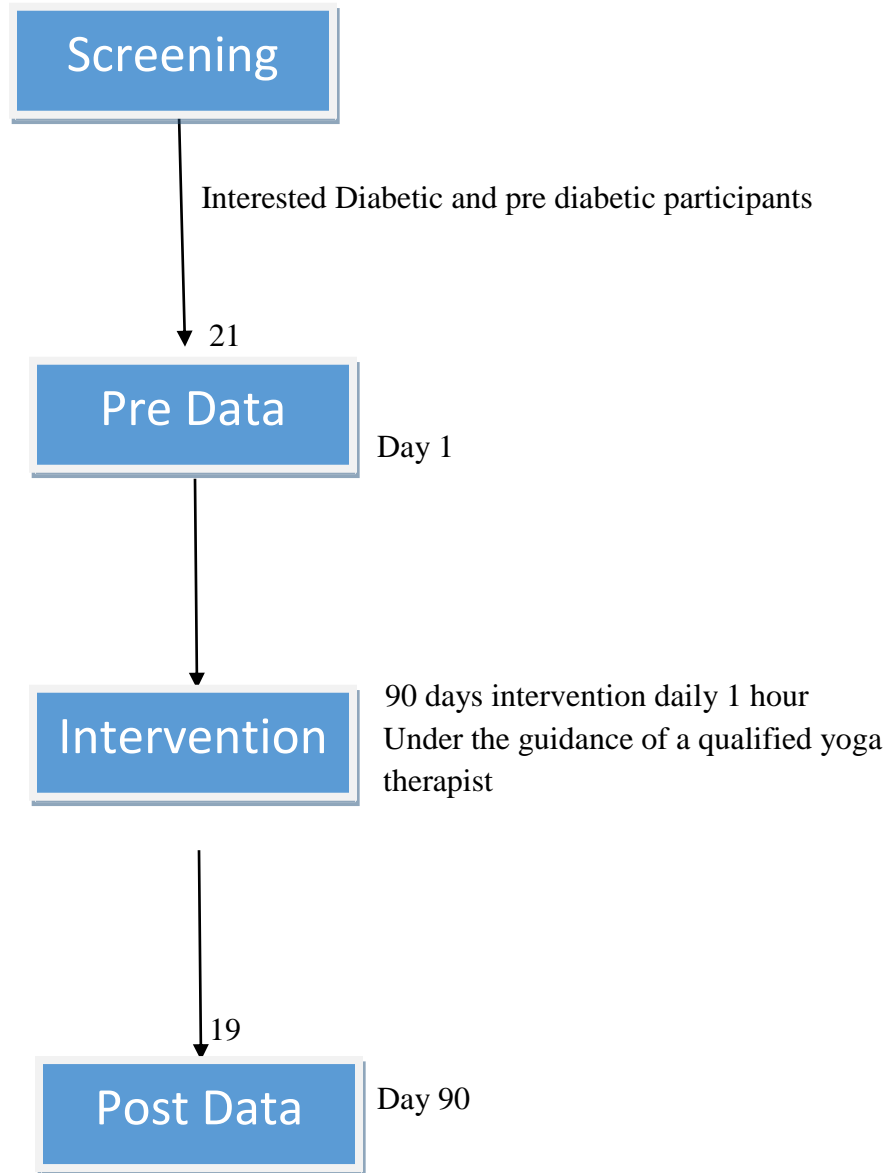
Sample size

The sample size was 19.

Procedure

The researcher went to the allocated village, does a door to door survey to identify subjects with diabetes mellitus and pre-diabetic using data sheet. After making a note of the identification, the subjects are assessed for various parameters. IAYT is given as an intervention to those subjects who have diabetes mellitus and pre-diabetic and are willing to participate in the study. After the intervention, the subjects are reassessed for the primary and the secondary outcome variables. The collected data is analyzed for the prevalence of the condition (Diabetes Mellitus and pre-diabetic) and the effect of IAYT.

Flowchart of the study



Ethical clearance and consent

The Institute Committee Approval (SVYASA) was obtained before the starting of the study. The heads of the villages were explained the details of the study and their oral consent was sought to conduct the survey. Each participant who participated in yoga was also explained in detail about the study and written informed consent was obtained from them to participate in the study. (Details in the Appendix)

Inclusion criteria

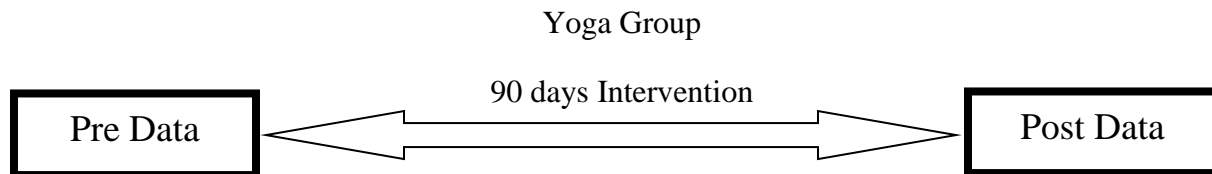
The participants who are diagnosed with type-II diabetes and pre-diabetes, along with oral hypoglycemic agents & on insulin, with or without the medical condition of hypertension and obesity. The age range of the subjects was above 20Yrs and below 70 years in both genders; those who can follow the yoga protocol.

Exclusion criteria

The subject having the history of any major surgery, tuberculosis, a neurological or psychiatric disorder in the past, severe, unstable myocardial ischemia, congestive heart failure or another severe cardiac disease, severe hypertension, and physical challenge was excluded. Those who were planning to move out of the area during the intervention were also excluded. Those who have documented cognitive impairment that would interfere with the ability to comprehend the informed consent and actively participate in the study were also excluded.

DESIGN OF THE STUDY

One arm Pre-Post Design



METHODS AND MATERIAL

INTERVENTION

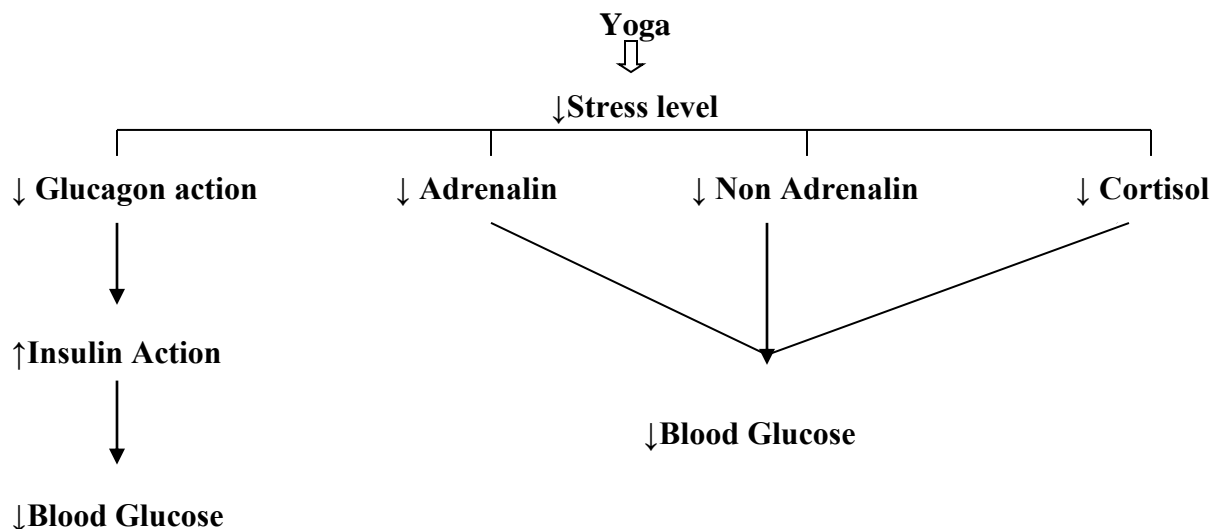
Yoga Practice is given to the pre-diabetes and diabetes participants who agreed to participate in the study for 3 months, 6 days in a week for 1hour. Yoga module consists of asana, pranayama, meditation, and relaxation techniques. The yoga practice module has been prepared by AYUSH MANTRALAY, INDIA which is placed in Appendix.

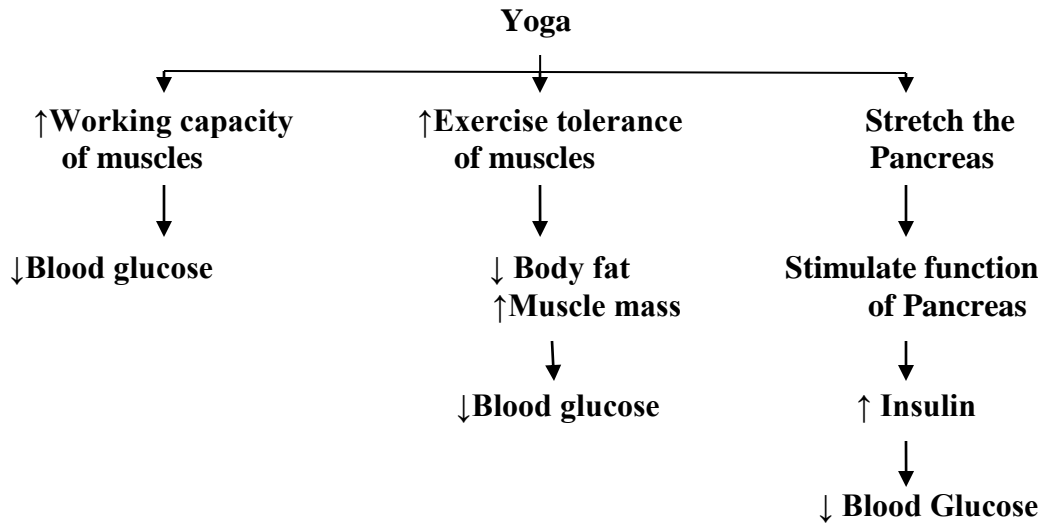
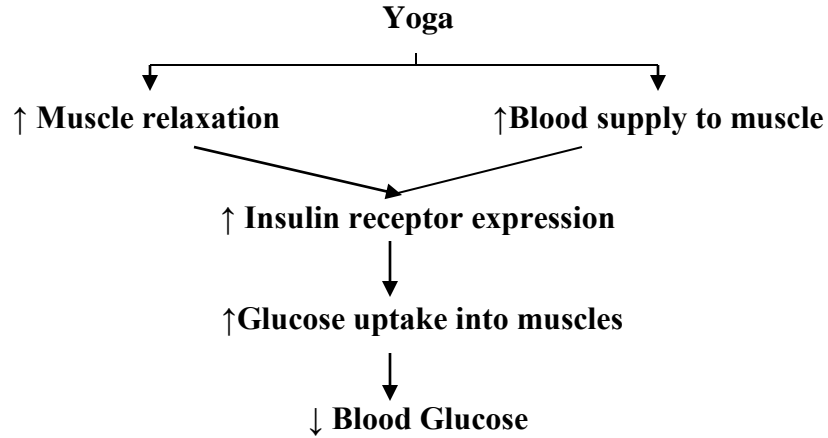
VARIABLES STUDIED

Blood Test

All baseline blood samples were collected from the subjects after an overnight fasting period of 8-12 hours, from the arm using a syringe. Blood samples took from the vein in the antecubital fossa. During blood collection, the arm rested on a pillow or other supportive prop. The phlebotomist sets the tourniquet around the upper arm of the subject, searches the proper vein by inspecting and palpating and then sterilizes the injection site. The vein can be anchored by placing the thumb about two centimeters below the vein and pulling gently to make the skin a little taut. After that, the needle, beveled upward, should be pushed smoothly and quickly into the vein, to minimize the possibility of hemolysis as a result of vascular damage. Immediately after the insertion, the tourniquet is released to minimize the effect of her concentration.(“Enclosure 02 NMB Final Proposal IEC,” n.d.)Further, the samples are analyzed for FBS, PPBS, HbA1C, and Lipid Profile in a NABL accredited lab.

How yoga works in DM – Mechanism





The possible mechanisms of how yoga contributes in the reduction of HbA1c levels is by effectively reducing the stress levels thus reducing the glucagon action (whose secretion is increased by stress), thereby improving insulin action. By reducing the stress, yoga reduces the levels of adrenaline noradrenalin and cortisol too which is a likely mechanism of enhanced insulin action as proved by the study done by Dr. Sujit Chandratreya, MD DM DNB Endocrinologist & Diabetologist. Yoga practice causes muscle relaxation and also the development and increased blood supply of the muscle which will increase the insulin receptor expression of the muscles causing increased glucose uptake by the muscles and thus reducing the

blood glucose levels. Doing yoga regularly, increases the working capacity of the muscles and also the exercise tolerance, which ultimately results in decreased body fat and increased muscle mass, a contributing factor for getting the blood glucose levels under control. Another possible mechanism by which yoga contributes for decreased blood sugar level is, many postures do produce stretch on the pancreas which is likely to stimulate the function of pancreas.(Muthuselvi et al., 2017)

Regular practice of yoga will reduce stress level. This effect would reduce sugar level in the body.FBS, PPBS though are good and immediate measures, sometimes slight variations in the diet may cause giving a wrong opinion about sugar levels.

E.g.: the day of sugar test if one has gone to a function (festival) meal, the results of FBS, PPBS will be very high compared to that person normal level.

Whereas HbA1c being 3 months average slight fluctuations of diet once in a way would not directly affect the data. In ancient India yoga was followed as a way of life, which includes changes in mental attitude, diet, and the practice of Asanas, pranayama, and meditation(Ghosh, 2015); regular exercise improves insulin sensitivity and blood glucose uptake in subjects with diabetes(Pa & Varne, 2017). There was a significant reduction in diabetes in fasting and post-prandial blood sugar level, after the intervention of three-month yoga and pranayama(Ghosh, 2015).Yoga helps to reduce weight, improve blood supply to various muscles and reducing stress hormones by improving the release of insulin from the pancreas(Maninder, Seema, & Shema, 2013). Pre-diabetes, modest amounts of weight loss and regular physical activity are much more effective in preventing or delaying the onset of type 2 diabetes (Kamani et al., 2017). The ancient Indian physicians, Sushruth and Charaka had a good knowledge about diabetes, the importance of diet and exercise in the management of diabetes (Sahay, 2007).

Yoga is an ancient tradition, Indian psychological, a physical and spiritual exercise that has been studied for the management of several chronic epidemic diseases. In diabetes, various yoga asana breathing exercise, meditation, and relaxation may be directly rejuvenated cells of the pancreas as a result of which there may be an increase in utilization and metabolism of glucose in the peripheral tissues, liver, and adipose tissues through enzymatic processes. Aljasir, Bryson, and Al-Sheri (2010) and Innes and Vincent (2007) in there systematic reviews on yoga-based

program on management of DM 2 adults concluded there is growing evidence that yoga practice may aid in the prevention and management of DM 2, reduce IRS-related risk factors associated with DM 2(Vaishali et al., 2012).

DATA EXTRACTION

Data is extracted from the participants using the following tools:

In the datasheet personal details of the participants like name, age, gender, occupation, income etc. are collected. HbA1c of the selected samples took before and after starting with the intervention.

DATA ANALYSIS

Data extraction and statistical analysis done using excel and R software respectively. Out of the 19 members, there were 9 female and 10 male and their age range from 34 to 60 years. The mean pre HbA1c is 7.89 with SD 2.01. The post means HbA1c is 7.51 with SD 1.88. Since the values follow a normal distribution, the t-test is monitored using R. The results showed that $P < 0.001$ indicating that the reduction in HbA1c is statistically significant. This indicates that 3 months of yoga practice one hour per day has significantly reduced HbA1c. RESULTS

RESULT

DEMOGRAPHIC DATA OF PARTICIPANTS

	CATEGORY	NO. OF PARTICIPANTS	PERCENTAGE
	TOTAL	19	100%
GENDER	MALE	10	53%
	FEMALE	9	47%
AGE	35-45	6	32%
	46-60	13	68%
HEALTH STATUS	DM	12	63%
	PRE-DM	7	37%

Table 1: Demographic data of participants.

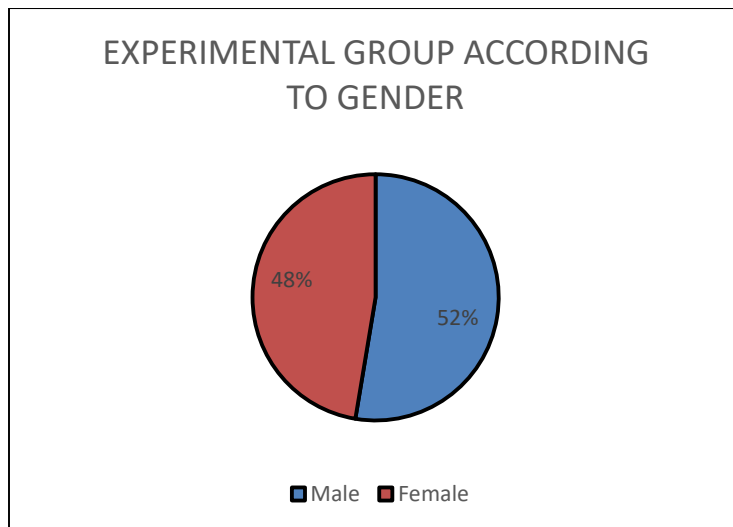


Figure 2: Population according to Gender

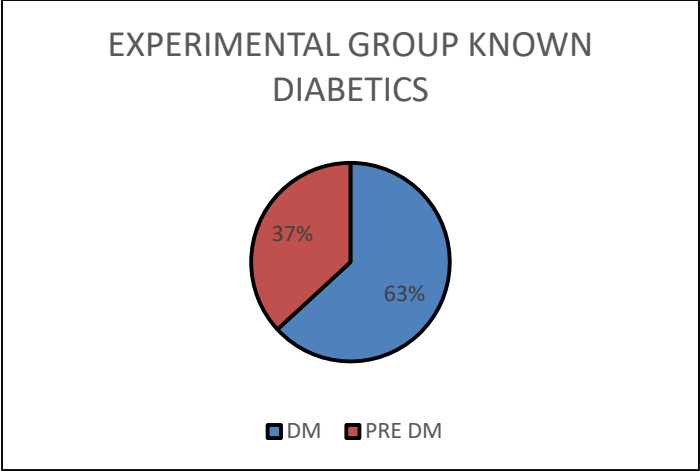


Figure 3: Health status of participants.

Table: Results of Glycated hemoglobin (HbA1c)

Variable		Mean	SD	ES	%Change	P-Value
HbA1c	Pre	7.89	2.01	0.195	4.8	0.001
	Post	7.51	1.88			

HbA1c: Glycated hemoglobin, **SD:** standard deviation, **ES:** effect size, **%:** percentage changes.

Glycated hemoglobin (HbA1c) showed a significant reduction ($p < 0.05$) from 7.89 ± 2.01 to 7.51 ± 1.88 . The effect size is 0.1 with 4.8% changes.

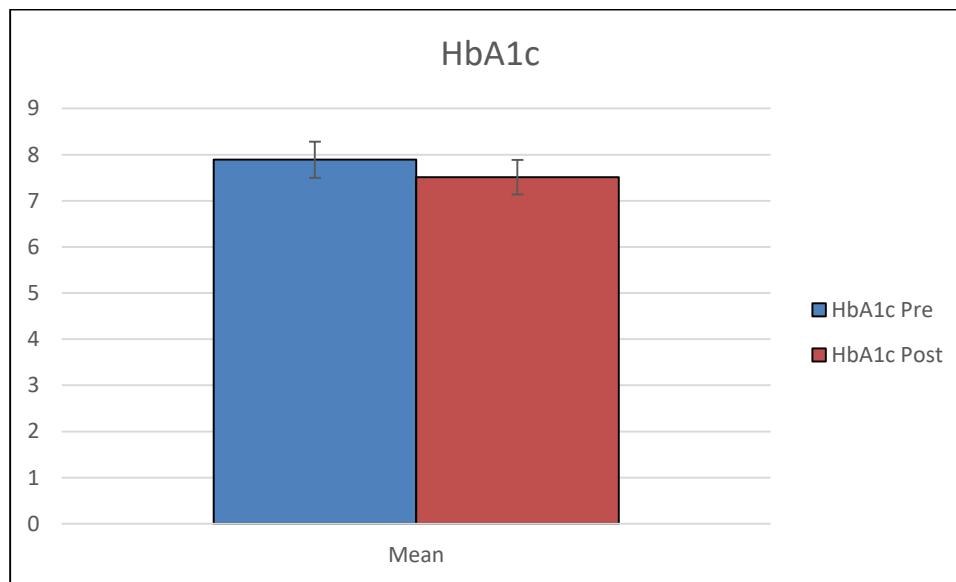


Figure4: Results of Glycated hemoglobin (HbA1c)

DISCUSSIONS

There is a statistically significant change in HbA1c level after 3 months of yoga practice. The mean percentage of change is 4.8. The effect size is 0.1.

COMPARISON WITH PREVIOUS STUDY:

S.No	Author	Subjects	Intervention	Mean and % change
1	(Vaishali et al., 2012)	N=60	12weeks of Yoga	Mean 10.25 to 9.12 with 11.28% change
2	(Mohan et al., 2015)	N=30	60 days of Yoga	Mean 9.41 to 7.07 with 24.86% change
3	(Nagarathna et al., 2012)	N=141	9 months of Yoga	Mean 8.54 to 7.33 with 14.16% change
4	Present study	N=19	3 months of yoga	Mean 7.89 to 7.51 with 4.8%

APPRAISAL

SUMMARY AND CONCLUSION

The current study showed a significant reduction in the yoga intervention of pre glycosylated hemoglobin (HbA1c) between post glycosylated hemoglobin (HbA1c).

IMPLICATIONS AND APPLICATIONS OF THE STUDY

STRENGTH OF THE STUDY

The intervention of this study was for 3 months. And also the results can be generalized to a similar population. The yoga module is not only limited to Asanas but also the different aspect of yoga such as Breathing practices, Pranayama, and Relaxation techniques were included in the intervention. Only the participant within the age range of 35-60yrs participated in the study.

LIMITATIONS OF THE STUDY

The present study is lacking in control group and also the sample size is very less. Many of those identified with diabetes could not take part in the present study due to their time schedule. This study has covered only one part of the town that is Shivanagara-21 and Kuntlu Reddy layout-18 of Jigani Anekal, Bangalore.

SUGGESTIONS FOR FUTURE STUDIES

Presence of the control group can make the research stronger. Long-term study with continuous follow up needed.

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APPENDICES

INFORMED CONSENT: A SAMPLE COPY

Consent form Information to the participants:

We understand that you are a resident of Jigani area, Bangalore. In this study, we are evaluating the prevalence of type2 diabetes in South Bangalore. Studies show that the practice of yoga has a positive influence on the overall quality of life in type2 diabetics.

Thus, this study conducts as a part of the MSC Yoga Therapy Degree program, examines the prevalence of type2 diabetes in Jigani area. Your consent is sought to take part in the study. If you consent to take part in this study, the interviewer will interview you. In this interview, the interviewer will ask you questions related to family health and diabetes. The information collected from you would be helpful in understanding the prevalence of diabetes in Jigani area. The interview may take half an hour. Apartof this interview, if you are observed to have symptoms of pre-diabetes, then you would also be asked to undergo the certain biochemical test (such as HbA1c). You will not be charged for this test. Please note that you have a right to refuse to take part in the study any time. Your refusal will not adversely affect your daily routine. Please also note that the information you are going to divulge to us will be kept in utmost confidentiality

Undertaking by the investigator:

If you have any doubts about the study please feel free to clarify. Even during the study, you are free to contact the investigator for clarifications if you so desire. The phone number of the investigator is given below.

Sanchi Vaid_____9611703555

Consent: I have been informed about the procedures of the study. The possible risks to have been explained to me as stated in the information. I have understood that I have the right to refuse my consent towithdrawingat any time during the study without adversely affecting me. I am aware that by subjecting to the investigation, I will have to give more time to assessments by the investigator and that these assessments do not interfere with the benefits.

IAYT INTERVENTION

S.NO	PRACTICE	ROUNDS	TIME DURATION
1	Breathing Practice		
	Hand stretch breathing	5	2 min
	Ankle breathing	5	1 min
	Tiger breathing	5	1 min
	Straight leg raise breathing	5	1 min
2	Suryanamaskara	6	6 min
3	Instant Relaxation technique (IRT)		3 min
4	Loosing Exercise		1 min
	Jogging		1 min
	Forward and Backward Bending		1 min
	Side Bending		1min
	Twisting		1 min
	Pavanamuktasana Kriya		1 min
	Dhanurasana swing		1 min
5	Quick relaxation technique (QRT)		4 min
6	Yogasana		1 min
	Ardhakatichakrasana		1 min
	Padahastasana		1 min
	Parivratatrikonasana		1 min
	Vakrasana		1 min
	Ardhamatsyendrasana		1 min

	Bhujangasana		1 min
	Dhanurasana		1 min
	Sarvangasana		1 min
	Matsyasana		1 min
			1 min
7	Deep Relaxation Technique		7 min
8	Pranayama		
	Kapalbhati	20	1
	Vibhagiya pranayama	5	1
	Nadisudhhi	9	1
	Sitkari	9	1
	Bhramari	5	1
9	Meditation		
	Nadanusandhana		10
	OM meditaion		5

RAW DATA

SL NO	REGISTRATION NO	AGE	SEX	Pre HBA1C	Post HBA1C	Pre RESULT
1	KA/BEN/JIGI/14/01	38	Female	9.5	9.7	Dm
2	KA/BEN/JIGI/13/28	35	Male	11.3	11.1	Dm
3	KA/BEN/JIGI/10/24	50	Female	9.2	8.1	Dm
4	KA/BEN/JIGI/06/14	50	Female	6.4	6.4	Pre Dm
5	KA/BEN/JIGI/12/24	58	Female	6.7	6.1	Dm
6	KA/BEN/JIGI/14/50	37	Male	6.7	6.8	Dm
7	KA/BEN/JIGI/14/33	55	Female	6.2	6.1	Pre Dm
8	KA/BEN/JIGI/14/34	60	Male	6.4	6	Pre Dm
9	KA/BEN/JIGI/15/17	48	Female	7	6.1	Dm
10	KA/BEN/JIGI/06/18	54	Male	7.3	6.8	Dm
11	KA/BEN/JIGI/06/27	35	Female	8.7	9	Dm
12	KA/BEN/JIGI/13/23	40	Female	9.6	8	Dm
13	KA/BEN/JIGI/08/17	38	Male	5.7	5.5	Pre Dm
14	KA/BEN/JIGI/04/18	44	Female	12.6	11.7	Dm
15	KA/BEN/JIGI/07/25	57	Male	6.4	6.5	Pre Dm
16	KA/BEN/JIGI/09/07	45	Male	7.6	7.2	Dm
17	KA/BEN/JIGI/14/37	54	Male	10.4	9.7	Dm
18	KA/BEN/JIGI/13/30	34	Male	6.1	5.9	Pre Dm
19	KA/BEN/JIGI/14/45	56	Male	6.2	5.9	Pre Dm



