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Cinnamon and Diabetes: Efficacy on Blood Glucose Level in Patients with Type 2 Diabetes

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Complementary interventions could be effective for type 2 diabetic patients as they cause a decrease in blood glucose levels within the clinical range. Hence the study was aimed to conduct to determine the effectiveness of cinnamon on blood glucose levels in patients with type 2 diabetes. A quasi-experimental research design was adopted to conduct the study at Dr.Padmanaba polyclinic with samples of 30 type 2 diabetes patients who met the inclusion criteria. Patients were assigned to the experimental group (n=15) and the control group (n=15). Demographic variables were collected from the participants using a structured questionnaire followed by pre-test was done by checking the fasting and post-prandial blood sugar level for both the groups. The experimental group received 2gms of cinnamon daily in the morning on an empty stomach for 30 days along with routine medical management, whereas the control group received regular routine care. Post-test was done at the end of 30 days for both groups. Data were tabulated and analyzed using the SPSS package. The result of the study reveals that there is a statistically significant reduction in the level of in the fasting blood glucose level and post-prandial blood glucose level of $p<0.0001$ and $p<0.05$ among patients with type 2 diabetes. The findings of the present study concluded that the prescribed cinnamon is effective in lowering the blood glucose level among patients with type 2 diabetes mellitus. Hence, the cinnamon administration can be incorporated as an effective method in the management of diabetes mellitus after replicating the large study samples.

Introduction

Diabetes mellitus is a chronic metabolic disorder and one of the leading causes of death worldwide. About 422 million people have diabetes globally, amongst the majority living in low-and middle-income countries. Over the past few decades, both the incidence and the prevalence of diabetes have constantly been increasing and 1.6 million deaths are directly attributed to diabetes every year [1]. India is the second most affected by diabetes in the world after China and has an estimated 77 million people with diabetes. About one in six people (17%) in the world with diabetes is from India [2]. The prevalence rate of diabetes was 11.8% in people over the age of 50 years as per the 2019 National Diabetes and Diabetic Retinopathy Survey report released by the ministry of health and family welfare [3]. The majority of diabetes cases are of type 2 diabetes[4]. Type 2 diabetes mellitus is progressive in nature, where the pancreatic beta cells cannot secrete enough insulin, and at the same time, cells can become resistant to utilize the to regulate blood sugar. It can be caused by a variety of factors such as environmental like diet and lifestyle and some genetic links. There is epidemiologic data that suggest that 9 of 10 cases of type 2 diabetes are attributed to modifiable lifestyle factors [5]. The prevalence of type 2 diabetes in Indians may be due to environmental and lifestyle changes resulting from industrialization and migration [6]. The goal of therapeutic management of diabetes is to control and reach the normal level of blood glucose without hypoglycemia, without causing any disturbance in daily life activities, and without leading diabetes-related chronic complications such as heart disease, kidney disease, and damage to the nerve and eyes. The fasting blood sugar in type 2 diabetes can be controlled by diet and exercise; if not controlled by diet, oral drugs are used to maintain the therapeutic glucose level, which is associated with side effects resulting from long-term use [7].

A series of cost-effective complementary interventions can improve patient outcomes. Patients with type 2 diabetes are driven to manage their conditions through complementary medicine is different but the major therapies used are nutritional supplements,

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herbal medicines, spiritual therapies, relaxation techniques, and Yoga [8]. The prevalence of using CAM therapies among T2DM patients has reached as high as 70% [8-10]. Complementary medicine could be effective for diabetic patients; they cause a decrease in blood glucose levels by different mechanisms that could be helpful in patients' care and for their better quality of life which is confirmed by many studies [11]. Studies also showed that most diabetic patients use herbal medicines more than the other supplemental therapies because they believe that herbal medicines are natural and healthy, whereas in poor quality and with improper use, they can be harmful and cause adverse effects [12,13].

Previous studies have reported and argued that cinnamon helps lower blood sugar in people with diabetes. Results from a clinical study suggest that cassia cinnamon improves blood glucose and cholesterol levels in people with type 2 diabetes and may reduce risk factors associated with diabetes and cardiovascular disease [14]. The chemical compound of hydroxy chalcone in cinnamon acts as an insulin-mimetic in 3T3-LI adipocytes, and Cinnamtannin B1 is an antioxidant, has been linked to the insulin-like biological activity of cinnamon, thereby enhancing the activity of insulin[15]. Procyanidin type-A polymers in cinnamon help to improve insulin receptor autophosphorylation and, thus, effect by increasing the sensitivity to insulin[16]. It has also been shown that cinnamon, which is rich in polyphenolic components, reduces oxidative stress and corrects impaired preprandial glucose if consumed 500mg/dl a day for 12 weeks [17]. Cinnamon activates the insulin receptor kinase, increasing glucose uptake, autophosphorylation of the insulin receptor, and glycogen synthase activity [18]. It has been stated that cinnamon increases glycogen storage by affecting glycogen synthesis activity [19]. A randomized controlled trial found that not enough evidence is available to support the use of cinnamon as a method for controlling blood sugar [20], and another study also found no improvement in blood glucose levels [21]. Despite numerous studies, some studies have shown a benefit from the cinnamon; some studies have not found any significant changes. Considering the potential benefit of and keeping in mind the controversial effect of cinnamon, the current study was aimed at conducting the effect of consumption of cinnamon on blood glucose levels among patients with type 2 diabetes.

Materials and Methods

A quasi-experimental research design was adopted to investigate the efficacy of consumption of cinnamon on blood glucose levels in type 2 diabetes patients. The study was conducted at Dr.Padmanaba polyclinic in Chennai after obtaining formal permission from the concerned authority. Thirty types two diabetes patients were selected for the study by using a convenience sampling technique and were assigned to the experimental group (n=15) and the control group (n=15). Both male and female patients were diagnosed to have type 2 diabetes with the age group of more than 30 years and on either regular or irregular treatment whose fasting blood glucose level is more than 115mgs/dl and willing to give consent to participate in the study were included in the study. The exclusion criteria were type II diabetes patients who had a history of gastric ulcer, allergic reaction to cinnamon, and were taking any cinnamon-related home remedies. The participants have explained the purpose of the study and obtained informed consent from the participants. Demographic variables and clinical variables were collected by using a structured questionnaire. Pre-test assessment of fasting and post-prandial blood glucose level was checked for both groups using a glucometer, and this measurement was standardized with the lab report. The experimental group was received 2gm of cinnamon for 30 days on an empty stomach in the morning along with routine medical treatment. Cinnamon was consumed in the form of tea which was prepared in 100 ml of water without adding any flavored agent. The post-test assessment of both fasting and post-prandial blood glucose levels was done at the end of 30 days by using the same tool. Confidentiality was assured throughout the study. The data were tabulated and analyzed by descriptive and inferential statistics using SPSS statistical package. A probability of 0.05 or less was taken as statistically significant.

Results

Table 1 shows that most of the Type 2 diabetes patients in the experimental group, 4(26%), 7(46.7%) had diabetes mellitus for >5 years, 12(80%) had an oral hypoglycemic agent as treatment, 15(100%) were on regular treatment, and 7(46.6%) used bitter guard as a home remedy for diabetes mellitus. Whereas in the control group, shows that most of the Type 2 diabetes patients in the control group, 4(26.7%) were aged between 40 – 50 years and 50 - 60 years respectively, 15(100%) were female, 9(60%) had diabetes mellitus for >5 years, 11(73.3%) had an oral hypoglycemic agent as treatment, 15(100%) were on regular treatment and 7(46.6%) used curry leaf as a home remedy for diabetes mellitus.

The table 2 shows that in the pre-test, all 15(100%) had diabetes in both the experimental and control group. Whereas in the post-test, the percentage of diabetes was reduced from 100% to 60% in the experimental group, and in the control group, no changes were observed.

Table 1: Frequency and percentage distribution of demographic variables of Type 2 diabetes in both experimental and control group

Demographic Variables	Experimental Group		Control Group	
	No.	%	No.	%
Age in years				
30 - 40 years	4	26.7	2	13.3
40 – 50 years	4	26.7	4	26.7
50 – 60 years	3	20.0	4	26.7
>60 years	4	26.7	5	33.3
Gender				
Male	1	6.7	0	0
Female	14	93.3	15	100.0
Duration of diabetes mellitus since				
<1 year	-	-	-	-
1 – 3 years	3	20.0	2	13.3
3 – 5 years	5	33.3	4	26.7
>5 years	7	46.7	9	60.0
Method of treatment				
Oral hypoglycemic agent	12	80.0	11	73.3
Insulin	3	20.0	4	26.7
Both	-	-	-	-
Are you on regular treatment?				
Yes	15	100.0	15	100.0
No	-	-	-	-
Are you on home remedies for diabetes mellitus				
Bitter guard	7	46.6	3	20.0
Fenugreek	3	20.0	5	33.3
Curry leaf	1	6.7	7	46.7
Others	4	26.7	0	0

Table 2: Frequency and percentage distribution of level of Fasting blood sugar level and among Type 2 diabetes patients in the experimental and control group

Fasting Blood Sugar Level	Experimental Group				Control Group			
	Pre-Diabetes (101 – 125 mg/dl)		Diabetes (≥126 mg/dl)		Pre-Diabetes (101 – 125 mg/dl)		Diabetes (≥126 mg/dl)	
	No.	%	No	%	No	%	No	%
Pre-test	0	0	15	100.0	0	0	15	100
Post-test	6	40.0	9	60.0	0	0	15	100

Table 3: Frequency and percentage distribution of level of Post Prandial blood sugar level and among Type 2 diabetes patients in the experimental and control group

Post Prandial blood sugar Level	Experimental Group				Control Group			
	Pre-Diabetes (101 – 125 mg/dl)		Diabetes (≥126 mg/dl)		Pre-Diabetes (101 – 125 mg/dl)		Diabetes (≥126 mg/dl)	
	No.	%	No	%	No	%	No	%
Pre-test	0	0	15	100	0	0	15	100
Post-test	5	33.33	10	66.67	0	0	15	100

Table 4: Effectiveness of cinnamon tea on fasting and post-prandial blood glucose level among type 2 diabetes patients in the experimental group

Variables	Assessment	Mean	S.D	Paired 't' test Value
Fasting Blood Sugar Level	Pre-test	184.0	19.08	t = 13.266 p = 0.0001 S***
	Post Test	140.33	18.95	
Post Prandial Blood Sugar Level	Pretest	313.67	77.36	t = 5.750 p = 0.05 S*
	Post Test	241.80	44.23	

***p<0.001, *p<0.05, S – Significant

Table 3 shows that in the pre-test, all 15(100%) had diabetes in both the experimental and control group. Whereas in the post-test, 10(66.67%) had diabetes in the experimental group, and all 15(100%) had diabetes in the control group.

Table 4 reveals the pre-test and post-test mean score of fasting blood glucose level was 184.0 ± 19.08 and 140.33 ± 18.95. The calculated paired't' test value of fasting blood glucose t = 13.266 and was found to be statistically highly significant at $p<0.001$ level. Table 4 also shows that the pre-test means a score of post-prandial blood glucose level was 313.67 ± 77.36 and 241.80 ± 44.23. The calculated paired't' test value of post-prandial blood t = 5.750 and was found to be statistically significant at $p<0.05$ level. This clearly infers that the administration of cinnamon tea is effective in lowering both fasting and post-prandial blood glucose level in type 2 diabetes patients in the experimental group.

The post-test mean score of fasting bleed glucose level of the experimental and control group was compared by unpaired t-test, and the calculated value of t was t = 5.275was found to be statistically significant at $p<0.001$ level. The post-test mean score of the post-prandial bleed glucose level of the experimental and control group was also compared by unpaired t-test, and the calculated value of t was t = 2.962 was found to be statistically significant at $p<0.001$ level. This clearly shows that there was a significant difference between the post-test level of fasting and post-prandial blood glucose level in type 2 diabetes patients between the experimental and control group as shown in table 5.

Table 6 shows that the demographic variable method of treatment had shown statistically significant association with the post-test level of fasting blood sugar among Type 2 diabetes patients in the experimental group at $p<0.05$ level.

The demographic variable age had shown statistically significant association with the post-test level of post-prandial blood sugar among Type 2 diabetes patients in the experimental group at $p<0.05$ level as shown in table 7.

Discussion

Spices such as cinnamon, walnut, green tea, and mint have similar effects on insulin action and out of which cinnamon is the most bioactive product [13] and also commonly used spice. The current study has actively investigated the effect of cinnamon on blood glucose levels and observed the significant changes in both fasting and post-prandial blood glucose levels. The present study was supported by the study conducted by Nildem Kizilaslan et al., that concluded the difference between the average post-prandial blood glucose measurements was found to be significant in the individuals consuming 6g of cinnamon per day and also found the difference between the average post-prandial blood glucose measurements before consumption on days 20 and 40 was significant in the

Table 5: Comparison of pre-test and post-test levels of fasting and post prandial blood sugar among Type 2 diabetes patients between the experimental and control group

Variables	Assessment	Mean	S.D	Unpaired 't' test Value
Fasting Blood Sugar	Experimental group Post-test	140.33	18.95	t = 5.275 p = 0.0001 S***
	Control group Post Test	174.00	15.87	
Post-Prandial Blood Sugar	Experimental group Post-test	241.80	44.23	t = 2.962 p = 0.0001 S***
	Control group Post Test	290.93	46.60	

**p<0.001, S – Significant

Table 6: Association of post level of post-prandial blood glucose among Type 2 diabetes mellitus patients with their selected demographic variables in the experimental group

Demographic Variables	Pre-diabetes		Diabetes		Chi-Square Value
	No.	%	No.	%	
Method of treatment					
Oral hypoglycemic agent	7	46.6	4	26.7	χ^2=4.773 df=1 p = 0.029 S*
Insulin	0	0	4	26.7	
Both	-	-	-	-	

*p<0.05, S – Significant

Table 7: Association of post level of post-prandial blood glucose among Type 2 diabetes mellitus patients with their selected demographic variables in the experimental group

Demographic Variables	Pre-diabetes		Diabetes		Chi-Square Value
	No.	%	No.	%	
Age in years					
40 years	3	20.0	0	0	χ^2=8.772 d.f=3 p = 0.032 S*
40 – 50 years	1	6.7	4	26.7	
50 – 60 years	3	20.0	0	0	
>60 years	1	6.7	3	20.0	

*p<0.05, S – Significant

individuals consuming 1g, 3g, and 6g of cinnamon per day [22]. Similarly in another study by Hlebowicz J et al., 2007 who have studied the effect of cinnamon on postprandial blood glucose, gastric emptying, and satiety in healthy subjects and concluded that the addition of 6 g cinnamon in rice pudding reduces post-prandial blood glucose and delays gastric emptying without affecting satiety[12]. B Mang et al., 2009 had conducted a study on the effects of a cinnamon extract on plasma glucose, HBA, and serum lipids in diabetes mellitus type 2 and proved the decrease in plasma glucose correlated significantly with the baseline concentrations from 4months cinnamon intake [23]. This finding is strongly supported by Serawit Denyo et al., 2019 who reported that cinnamon significantly reduced fasting blood glucose (FBG) and homeostatic model assessment for insulin resistance (HOMA-IR) level compared to placebo in meta-analysis and meta-aggression on efficacy and safety of cinnamon in type 2 diabetes mellitus and pre-diabetes patients[24]. Maria Alexandra Bernardo et al., 2015 also reported that cinnamon tea ingestion also results in a significantly lower post-prandial maximum glucose concentration and variation of maximum glucose concentration [25]. However, the present study found that highly significant reduction in fasting blood glucose level when compared to the post-prandial blood glucose. Moreover, post-test level of fasting sugar level is significantly associated with the method of treatment. Similarly, post-prandial blood glucose level is associated with age group, which shows that age and method of treatment may influence the findings of the study. Studies have been reported that cinnamon has a toxic effect on the liver especially consuming cinnamon with anti-diabetic drugs [26]. So precautionary measures were taken before the start of the intervention, and also no side effects were observed after consuming cinnamon. In a study by Paul Crawford2009, it was found that cinnamon lowered HbA1C compared with usual care alone, lowering HbA1C after consumption of 1g cinnamon daily for 90 days[27]. In another study by Alam Khanet al, 2003 who demonstrated that intake of 1, 3, or 6 g of cinnamon per day for 40days reduced the mean fasting serum glucose 18–29% and also reduced the triglyceride, LDL cholesterol, and total cholesterol in people with type 2 diabetes [14]. Anne-Marie Roussel et al., 2009 showed that consuming 500 mg of cinnamon extract daily for 12 weeks decreased a marker of oxidative stress by 14% in adults with pre-diabetes [17]. The current study is limited to observing the measurement ofHbA1C, lipid profile, and oxidative stress among patients with type 2 diabetes mellitus. A study by Farzaneh Hasanzade et al., 2013 found that cinnamon consumption for 60 days did not change the glucose level of diabetic patients [21]. This finding is in contrast with current study findings. Hence the current

study suggests conducting a further study with a longer duration of intervention, and by measuring HbA1C, lipid profile and oxidative stress, body mass index as cinnamon help to reduce the body weight and also to calculate the exact dosage and frequency of cinnamon consumption among patients with diabetes mellitus.

Conclusion

The findings of the present study concluded that the prescribed cinnamon is effective in lowering the fasting blood glucose level among patients with type 2 diabetes mellitus. It is also a simple, safe, cost-effective, and non-pharmacological method that could be easily prepared by anybody at home, and it does not cause any side effects. Hence, cinnamon administration can be incorporated as an effective method in the management of diabetes mellitus.

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References

1. https://www.who.int/health-topics/diabetes. Retrieved 10.09.2021
2. Kannan, Ramya (2019-11-14). India is home to 77 million diabetics, second highest in the world. The Hindu. ISSN 0971-751X. Retrieved 2020-04-29.
3. Sharma, Neetu Chandra (2019-10-10). Government survey found 11.8% prevalence of diabetes in India. Livemint. Retrieved 2020-04-29.
4. AtreSachin, Addressing policy needs for prevention and control of type 2 diabetes in India, Perspect Public Health, 135(5), 257–263 (2015).
5. V.Mohan, Why are Indians more prone to diabetes? J Assoc Physicians India, 52, 468–474 (2004).
6. F.B. Hu, J.E. Manson, M.J. Stampfer, G. Colditz, S. Liu, C.G. Solomon, W.C. Willett, Diet, Lifestyle, and the Risk of Type 2 Diabetes Mellitus in Women., 345(11), 790-799 (2001).
7. M. Roghani, T. Baluchnejadmojarad, F. Roghani-Dehkordi, Survey the hypoglycemic and hypolipidemic effect of chronic oral administration of nigella sativa in diabetic rat., J Med FacGullan Univ Med Sci, 16(63), 26-31 (2007).
8. Hsiao-yun Chang, Marianne Wallis, EvelinTiralongo, Use of complementary and alternative medicine among people living with diabetes: Literature review., J AdvNurs, 58(4), 307-319 (2007).
9. Elisabeth Fabian, Sabine Töscher, Ibrahim Elmadfa, Thomas R Pieber, Use of complementary and alternative medicine supplements in patients with diabetes mellitus., Ann NutrMetab, 58(2), 101–108 (2011).
10. Peggy S Odegard, Mary M Janci, Melanie P Foeppel, Jennifer R Beach, Dace L Trence, Prevalence and correlates of dietary supplement use in individuals with diabetes mellitus at an academic diabetes care clinic., DiabetEduc, 37(3), 419–425 (2011).
11. AntoniettaZanini, Rosanna Quattrin, Debora Goi, Barbara Frassinelli, Mateo Panariti, IvanaCarpanelli, Silvio Brusaferro, Italian oncology nurses knowledge of complementary and alternative therapies: National survey., J AdvNurs, 62(4),451–456 (2008).
12. Joanna Hlebowicz, GassanDarwiche, Ola Björgell, Lars-OlofAlmér, Effect of cinnamon on post-prandial blood glucose, gastric emptying, and satiety in healthy subjects., Am J ClinNutr, 85(6), 1552–1556 (2007).
13. World Health Organization (WHO) Traditional medicine. [Last accessed on 2011 Feb]. Available from: http://www.who.int/mediacentre/factsheets/fs134/en/index.html .
14. Alam Khan, MS, MahparaSafdar, Mohammad Muzaffar Ali Khan, Khan Nawaz Khattak, Richard A. Anderson, Cinnamon Improves Glucose and Lipids of People With Type 2 Diabetes., Diabetes Care, 26(12), 3215-3218 (2003).
15. https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/cinnamon-extract
16. C.K. Chase, C.E. McQueen, Cinnamon in diabetes mellitus, American Journal of Health-System Pharmacy, 64(10), 1033-1035 (2007).
17. Anne-Marie Roussel, Isabelle Hininger, RachidaBenaraba, Tim N. Ziegenfuss, Richard A. Anderson, Antioxidant effects of a cinnamon extract in people with impaired fasting glucose that are overweight or obese., J Am CollNutr, 28(1), 16–21 (2009).
18. W.L. Baker, G. Gutierrez-Williams, C.M. White, J. Kluger, C.I. Coleman, Effect of cinnamon on glucose control and lipid parameters., Diabetes Care, 31(1), 41-43 (2008).
19. C.L. Broadhurst, M.M. Polansky, R.A. Anderson, Insulin-like biological activity of culinary and medicinal plant aqueous extracts in vitro., J Agric Food Chem, 48(3), 849–852 (2000).
20. Matthew J Leach, Saravana Kumar, Cinnamon for diabetes mellitus., Cochrane Database Syst Rev, 2012(9), CD007170(2012).
21. FarzanehHasanzade, Maryam Toliat, Seyyed Ahmad Emami, Zahra Emamimoghaadam, The Effect of Cinnamon on Glucose of Type II Diabetes Patients., J Tradit Complement Med, 3(3), 171-174 (2013).
22. NildemKizilaslan, NihalZekiyeErdem, The Effect of Different Amounts of Cinnamon Consumption on Blood Glucose in Healthy Adult Individuals., Int. J. Food Sci, 2019, Article ID 4138534, 1-9 (2019).
23. B. Mang, M. Wolters, B. Schmitt, K. Kelb, R. Lichtinghagen, D.O. Stichtenoth, A. Hahn, Effects of a cinnamon extract on plasma glucose, HBA, and serum lipids in diabetes mellitus type 2., Eur J Clin Invest, 36(5), 340-344 (2009).
24. SerawitDeyno, KassahunEneyew, SisaySeyfe, NaassonTuyiringire, Emanuel L. Peter, RekikAshebirMuluye, CasimUmbaTolo, Patrick EngeuOgwang ,Efficacy and safety of cinnamon in type 2 diabetes mellitus and pre-diabetes patients: A meta-analysis and meta-regression. Diabetes Res. Clin. Pract, 156, 107815 (2019).
25. Maria Alexandra Bernardo, Maria Leonor Silva, Elisabeth Santos, Margarida Maria Moncada, José Brito, Luis Proença, Jaipaul Singh, Maria Fernanda de Mesquita1, Effect of Cinnamon Tea on Postprandial Glucose Concentration., J. Diabetes Res, 2015, Article ID 913651, 1-6 (2015).
26. https://www.webmd.com/diabetes/cinnamon-and-benefits-for-diabetes
27. Paul Crawford, Effectiveness of cinnamon for lowering hemoglobin A1C in patients with type 2 diabetes: a randomized, controlled trial., J Am Board Fam Med, 22(5), 507-12 (2009).