Influence of relaxation training on glycaemic control, perceived stress and quality of life in type 2 diabetics

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Abstract

Relaxation techniques have the potential to impact the course of certain chronic diseases when applied persistently. This study examined the effect of a relaxation training programme on glycaemic control, perceived stress and quality of life in patients with type 2 diabetes. Seventy male and female patients with type 2 diabetes (mean age: 40.1±3.1) were randomised into either a relaxation training group (n = 35) or a control group (n = 35). Participants in the relaxation group were trained in muscle relaxation using Benson's relaxation technique with diaphragmatic breathing exercise for 20 minutes thrice weekly for 9 weeks while those in the control group received only routine diabetic management with diabetes-related information throughout the period of intervention. Glycosylated haemoglobin values were statistically significantly lower in the relaxation training group from baseline to follow up. Significant improvements in perceived stress and quality of life were also observed, over time, in the relaxation training group (P<0.05). Also, the three outcomes improved significantly in favour of the relaxation training group, compared to the control, at follow up (P<0.05). The findings indicated that relaxation training was a valuable non-pharmacologic intervention that can elicit decrease in glycosylated haemoglobin and perceived stress as well as enhance quality of life among individuals with type 2 diabetes. Therefore, the technique can be a useful adjunct intervention in the overall management of diabetes.

Key words: glycaemic control perceived stress; quality of life; relaxation technique; type 2 diabetes mellitus

Introduction

Type 2 diabetes mellitus (T2DM) is a chronic progressive endocrine disease affecting large numbers of people, globally, irrespective of ethnic origin and socio-economic status (Shaw, Zimmet, McCarty & de Courten, 2000). It is a complex multifactorial process with both heritable and acquired origins (Hamman, 1992) accounting for almost all individuals with diabetes mellitus (National Diabetes Data Group, 1993). With epidemic proportions being reached in many countries (Zimmet, 1992), the disease currently affects 415 million people worldwide (a prevalence of 8.8%) and about 673 billion US dollars were spent on healthcare for the disease (International Diabetes Federation, 2015). In Nigeria, the prevalence of diabetes in adults is 1.9% of the population with the number of deaths recorded being 40,815 (IDF, 2015), making the disease an important public health issue.

The management of diabetes entails active, continuous and usually protracted involvement of the patient. This monotonous participation in care can be overwhelming, tedious and frustrating and can potentially produce substantial negative impact on psychosocial wellbeing. Psychological concomitants such as stress and anxiety can interact with non-psychological factors to limit optimum metabolic control, physical exercise and function, with higher risk of complications (Murakami, et al., 2006). In addition to the well-known interventions for diabetes (oral antidiabetic medications and insulin supplementation with lifestyle adjustment related to diet and physical activity), complementary or alternative therapy such as relaxation training and exercise imagery, which can potentially modify the course of the disease, have also been used (Dunning, 2003). For example, relaxation training has been shown to produce reduction in catecholamines and decrease in autonomic nervous system activity eliciting physical and mental relaxation (Potter & Perry, 2013). Relaxation, in turn, enhances blood circulation and release of endorphins, thereby decreasing anxiety and stress level leading to blood

glucose regulation (Mcgrady, 2010) and improvement in psychological well-being.

In spite of the significant benefits of these psychological interventions, hardly have researchers paid attention to their application in clinical settings. Therefore, not much has been documented on these interventions for individuals with chronic diseases. In addition, few studies have focused on the effect of non-pharmacologic interventions on psychological health in diabetes. With diabetes increasingly becoming burdensome at both personal and societal levels, it is imperative to explore and incorporate simple, safe and cost effective non-pharmacological supportive interventions in the overall management of the disease with a view to curbing or reducing the menace of the epidemic. These interventions can play a vital role in the prevention or at least minimising associated complications as they augment pharmacotherapy and reduce the need for the use of medications which is associated with adverse effects. Moreover, the effects of relaxation in individuals with type 2 diabetes mellitus have been fully elucidated (Kaviani, Bahoosh, Azima, Asadi, Sharif & Sayadi, 2014). Therefore, this study investigated the influence of a relaxation training programme on glycaemic control, perceived stress and quality of life among patients with T2DM.

Method

Participants

The study, part of a larger research on exercise in diabetes, recruited male and female patients (aged between 30 and 60 years) with a diagnosis of T2DM and used a pretest/posttest, experimental design. Participants were recruited using purposive sampling and were randomised equally to either a relaxation training group (n = 35) or a control group (n = 35). The diagnostic criteria for diabetes was in accordance with the recommendations of the American Diabetes Association (2010). All patients were on oral hypoglycemic agents, had perceived stress score ranging from 18 to 37 and were attending the Outpatient Diabetes Clinic of the Murtala Muhammad Specialist Hospital (MMSH) for follow-up care. Ethics approval was obtained from the Kano State Hospitals Management Board and the study was conducted in strict adherence to the principles outlined in the Helsinki Declaration. The participants gave written informed consent prior to participation in the study. Exclusion criteria were presence of psychiatric condition or current use of any psychiatric medication, pregnancy or lactation, previous or current use of any relaxation technique and/or physical restrictions that would hinder the administration of the technique (e.g., wheelchair-bound or bed-ridden).

Sample size was determined using the Simple Interactive Statistical Analysis power computation for two-sample analysis (available at http://www.quantitativeskills.com/sisa/calculations/samsize.htm). The aim was to detect a clinically relevant treatment effect. Changes in HbA_{1c} levels from 8.13 ± 1.73 to 7.33 ± 1.09 in the relaxation group, and from 8.29 ± 1.63 to 8.17 ± 1.30 in the control group from a previous study (Tsujiuchi et al., 2002) were used with z for 1-power=0.84, z for alpha double sided=1.96 and power=0.80. The total sample size required was 70, i.e. 35 in each group, considering an attrition rate of 10%.

Relaxation Training

The Benson's relaxation technique was undertaken in a quiet part of the gymnasium in order to minimise distractions. In accordance with the guidelines (Tahmasbi & Hasani, 2016), the patients assumed a calm lying position in bed with the eyes closed and relaxed their muscles, beginning at the sole of the foot and progressing up to the face until all the muscles in the body were fully relaxed. Then, deep diaphragmatic breathing exercise was administered with the hand placed on the abdomen such that it lowered with exhalation and rose during inhalation as indicated by visible abdominal excursion (Fernandes, Cukier & Feltrim, 2011). The instruction was to take a deep breath (inhalation) through the nose, with exhalation through the mouth, and to utter hush 'relaxing words' of the participant's choice (e.g., God, love, joy or paradise) with each exhalation. Participants were reminded to breathe easily and naturally and to be aware of the breathing. This procedure was continued for 20 minutes (Tahmasbi & Hasani, 2016) at the end of which the participant remained in the lying position for 5 minutes before being discharged.

The training was administered, thrice weekly, in the Gymnasium of the Physiotherapy Department at the MMSH with participants being monitored throughout and at the end of each training session. All participants mastered the technique and were able to independently perform it. All data were obtained at baseline and at the end of the 9-week intervention period.

Control

This was a non-relaxation training group whose members underwent the same set of measurements described below. As it was for those in the relaxation group, participants in this group continued with their

routine medical treatment and received dietary counseling alongside general information about diabetes and related complications including ways to identify and avoid them.

Measures

Blood chemistry analysis:

Venous blood draw was performed, following an overnight fast of at least twelve hours, by a qualified laboratory scientist using venipuncture. The blood was transferred into cold tubes containing sodium fluoride and centrifuged to separate plasma from blood cells. This was stored at −70°C for later analysis of glycosylated haemoglobin (HbA_{1c}) using the mini-column ion-exchange chromatographic method (TECO Diagnostics, California, USA).

Assessment of perceived stress and quality of life

Level of perceived stress was measured using the 14-item Perceived Stress Scale (PSS) (Cohen, Kamarck & Mermelstein, 1983). The PSS measures perceptions of personal stress over the previous 4 weeks and has been well-validated (internal consistency [Cronbach's alpha co-efficient=0.85] and test-retest reliability during a short retest interval of 0.85) (Cohen, Kamarck & Mermelstein, 1983). Items evaluate the extent to which life is perceived as unpredictable, uncontrollable, overloaded, or unable to be handled and are rated on a 5-point Likert scale, ranging from 0 "Never" to 4 "Very often". Scores range from 0-56, with higher scores indicating greater perceived stress. The level of perceived stress was analysed by quartiles as suggested by Tavolacci, Ladner, Grigioni, Richard, Villet and Dechelotte (2013) since no cut-off scores have been established. The first quartile represented the less stressed individuals (a PSS score < 10), the second quartile (a PSS score of 10 – 15), the third quartile (a PSS score of 16 – 20), and the fourth quartile signifying highly stressed individuals with a PSS score > 20 (Tavolacci et al., 2013). The scale was interviewer-administered and participants were asked to report feelings consistent with their condition in the last one month using the tool either in English or in Hausa.

Quality of Life (QoL) was assessed using the Short Form Health Survey (SF-12) (Ware, Kosinski & Keller, 1996). This is a valid and reliable measure of generic health status that provides summary component scales for overall physical (Physical Components Summary [PCS]) and mental (Mental Components Summary [MCS]) health using norm-based methods (Ware, Kosinski & Keller, 1996). The SF-12 allows for self-assessment, in the preceding 4 weeks, of the following: physical activity, limitations due to physical problems on roles or activities, pain, emotional and general health status, vitality, social activities and mental health. Higher scores on the SF-12 correspond to a better subjective perception of QoL. Poor health status was defined as scores in the lowest quartile (PCS scores of ≤35; MCS scores of ≤45) (Arnold, Smolderen, Buchanan, Li & Spertus, 2012).

Statistical analysis

Statistical analyses were conducted using IBM ® SPSS, version 21 (SPSS Inc. Chicago. IL, USA). An intention-to-treat principle was applied with the MOTH (imputation [multiple] of the mean of the other group) method being used. The Kolmogorov-Smirnov test was used to assess whether data followed normal distribution. The independent samples *t*-test was used in detecting inter-group differences while the paired samples t-test determined differences between baseline and post intervention in each of the 2 groups. All statistical tests were two-tailed with an alpha level of 0.05 or less indicated statistical significance.

Results

A total of 70 patients, with a mean age of 40.1±3.11 years and a mean duration of diabetes of 5.83±1.59 years, diagnosed with T2D participated in the study (Table 1). Pre intervention, there were no differences between the groups with respect to the primary outcomes (HbA_{1c}, perceived stress and QoL as indicated by the physical and mental component scores of the SF-12 health survey) ($P>0.05$) (Table 1). There were statistically significant differences from baseline to follow up in the three primary outcomes for participants in the relaxation group, but not in the control group ($P<0.05$) (Table 2). Also, significant differences were observed ($P<0.05$) between the two groups post-intervention, indicating decrease in HbA_{1c} and perceived stress with increase in QoL for the relaxation training group compared with the control (Table 3).

Table 1: Participants' socio-demographics and clinical variables pre intervention

Variables	All participants N = 70	RTG N = 35	CON N = 35	t	*P*
Gender (M/F)	39/31 (44.3%)	20/15 (42.9%)	19/16 (45.7%)	-	-
Age (years)	40.1±3.11	39.0±4.88	38.9±4.90	0.895	0.449
Education (years)	11.5±2.90	10.9±3.10	11.1±2.34	0.341	0.329
DOD (years)	5.83±1.59	5.05±1.61	5.60±1.57	0.683	0.279
HbA_{1c} (%)	8.55±2.21	8.51± 2.88	8.31±2.49	0.664	0.819
PSS	22.3±2.91	24.3±6.12	23.9±6.10	0.487	0.222
PSC-12 (%)	36.9±7.90	35.33±6.51	35.33±7.60	0.346	0.712
MSC-12 (%)	44.9±4.96	45.20±4.89	44.91±6.51	0.487	0.118

Abbreviations: RTG, relaxation training group; CON, control group; DOD, duration of diabetes; HbA_{1c}, glycosylated haemoglobin; PSS, perceived stress score; PCS-12, physical component score of the short form 12 health survey; MCS-12, mental component score of the short form 12 health survey. Values are means ± SD unless otherwise indicated. *P* values are for the independent samples t-test analysis.

Table 2: Responses from baseline to post 9 weeks of intervention in each of the two groups

Variables	RTG			CON		
	Baseline	Post	*P*	Baseline	Post	*P*
HbA_{1c} (%)	8.51± 2.88	7.47±2.55	<0.05*	8.31±2.49	9.11±2.14	0.398
PSS	24.3±6.12	20.5±4.38	<0.05*	23.9±6.10	26.5±4.32	0.019*
PSC-12 (%)	35.33±6.51	48.2±4.43	<0.05*	35.33±7.60	35.90±3.47	0.334
MSC-12 (%)	45.20±4.89	50.66±5.90	<0.05*	44.91±6.51	45.11±5.66	0.289

Abbreviations: RTG, relaxation training group; CON, control group; HbA_{1c}, glycosylated haemoglobin; PSS, perceived stress score; PCS-12, physical component score of the short form 12 health survey; MCS-12, mental component score of the short form 12 health survey. Data are presented as means ± SD. *P* values are from the results of paired samples t-test analysis.
* indicates statistical significance.

Table 3: Post-intervention between-group comparison of variables

Variables	RTG N = 35	CON N = 35	t	ES	*P*
HbA_{1c} (%)	7.47±2.55	9.11±2.14	4.234	0.696	0.011*
PSS	20.5±4.38	26.5±4.32	1.291	1.379	0.023*
PSC-12 (%)	48.2±4.43	35.9±3.47	4.355	3.091	<0.05*
MSC-12 (%)	50.7±5.90	45.1±5.66	2.445	0.968	0.009*

Abbreviations: RTG, relaxation training group; CON, control group; ES, effect size; HbA_{1c}, glycosylated haemoglobin; PSS, perceived stress score; PCS-12, physical component score of the short form 12 health survey; MCS-12, mental component score of the short form 12 health survey. Data are presented as means ± SD. *P* values are from the results of independent samples t-test analysis.
* indicates statistical significance.

Discussion

This study investigated the effect of relaxation training on glycaemic control (glycosylated haemoglobin), perceived stress and quality of life in patients with T2DM and found positive effects (with large effect sizes) post intervention. The results lends support to what has been previously documented. A significant improvement in glycemic control was observed with biofeedback and relaxation training administered for 12 weeks in diabetic patients (McGinnis, McGrady, Cox & Grower-Dowling, 2005), supporting the findings of the present study. Surwit et al. (2002) also found significant improvement in HbA_{1c} after 12 months of a stress management programme.

A study by Lane, McCaskill, Ross, Feinglos and Surwit (1993) reported that there was no difference between relaxation training and conventional diabetes treatment for type 2 diabetics after an 8-week relaxation training programme. Also, Jablon, Naliboff, Gilmore and Rosenthal (1997) did not observe any improvement in glycaemic control in mildly stressed individuals with T2DM post relaxation training. More recently, Jacobson's progressive muscle relaxation training administered for 3 months did not elicit significant changes in HbA_{1c} in type 2 diabetics (Najafi Ghezeljeh, Kohandany, Oskouei & Malek, 2017) which also contradicts the findings of the present study. An explanation for the negative outcomes observed in these previous studies was, possibly, lack of strict adherence to the techniques used as participants were required to continue the programme at home unsupervised. In addition, there might be instances when the techniques were not even undertaken. In the present study, participants reported at the gymnasium three times per week and undertook the training under strict supervision to ensure it was administered properly.

Chronic physical disorders have been linked to a psychophysiological etiology (wherein a psychological condition leads to or aggravates physical symptoms) (Figueira & Ouakinin, 2008). The prevalence of mood and anxiety disorders has been reported to be higher in diabetics than in non-diabetics (Anderson, Freedland, Clouse & Lustman, 2001). This is attributable to the nature of management of the disease which entails persistent monitoring and the use of a multitude of interventions. More often than not, a diagnosis of diabetes induce anxiety due to the perception that the disease warrants a compelling need to modify lifestyle with the possibility of complications (such as painful neuropathy, blindness, sexual dysfunction, and macrovascular complications) occurring (Pouwer, 2009). As a cognitive or behavioral treatment approach, relaxation technique leads to the development of a *relaxation response* which helps to counteract the *stress response* of anxiety. The physiological mechanisms and adjustments that are elicited with engagement in habitual mental activity while passively ignoring distracting thoughts is known as the relaxation response (Esch, Fricchione & Stefano, 2003). The current investigation corroborates the findings of Ebrahem and Masry (2017) where a programme of relaxation training produced improvement in QoL and a reduction in perceived stress among patients with T2DM. Nevertheless, the results of a study by of Najafi et al. (2017) showed no positive changes in QoL among patients with T2D post relaxation training. The improvement observed in participants' QoL was most likely due to the decrease in perceived stress and improvement in glycaemic control as indicated by a reduction in participants' mean glycosylated haemoglobin.

Conclusion

Relaxation training can result in substantial improvement in glycaemic control, perceived stress and quality of life in patients with T2D. The technique has the attractiveness of being easy to administer, risk free and cheap. It can, therefore, be used as an adjunct with the other forms of diabetes management in ameliorating physical and mental distress and enhance overall quality of life.

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Conflict of interest

No conflicts of interest was declared related to this research.

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