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Improving glycaemic and BP control in type 2 diabetes

The effectiveness of tai chi

Background
This study assessed the effect of tai chi on glycosylated haemoglobin (HbA1c), blood pressure and health status (SF-36) in adults with type 2 diabetes.

Methods
A randomised controlled trial of tai chi classes for 6 months versus wait list control for adults with type 2 diabetes and a baseline HbA1c of 7% or more.

Results
A total of 53 patients were recruited to the study and randomised to tai chi (28) or control group (25). There were improvements in HbA1c; 6 m walk test, and total cholesterol between baseline and follow up but the difference between the two treatment groups was not statistically significant. Health status results showed improvements in three domains for the tai chi group.

Discussion
There was no significant improvement in metabolic control or cardiovascular risk at follow up compared to the control group. Patients in the tai chi group showed improvements in physical and social functioning.

Type 2 diabetes has been estimated to affect over 100 million people worldwide and its prevalence is expected to increase to 300 million by 2025.[1] Cardiovascular disease is a major complication and at least 65% of people with diabetes die from cardiovascular disease.[2] Weight reduction and exercise are recognised as treatment strategies to control blood glucose levels and reduce macrovascular risk factors thereby preventing complications such as cardiovascular disease.[1–4] People with diabetes who exercise regularly have better glycaemia control[5–8] and cardiovascular outcomes than those who do not exercise.[8–10]

Although moderate to vigorous intensity aerobic exercise and resistance training have been shown to improve all aspects of insulin resistance syndrome,[11] a large proportion of adults with type 2 diabetes do not follow recommended physical activity guidelines.[12] Tai chi offers a number of advantages as a form of exercise and has been demonstrated to decrease blood pressure (BP) and improve lipid profiles.[13] It is considered to be an enjoyable activity combining meditation and gentle movements involving the entire body and has been shown to have a high level of adherence.[14–17] It is readily adaptable to differences in physical functioning making it especially suitable for sedentary, overweight or disabled people and can be practised individually or in groups. The aim of this study was therefore to assess the effectiveness of tai chi versus wait list control on HbA1c and BP in adults with type 2 diabetes. A secondary aim was to explore the effect of tai chi on general health status as measured by the SF-36.

The study was approved by human research ethics committees of the University of New South Wales and registered with the Australian Clinical Trails Registry (ACTR number 12606000008527).

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Methods

We conducted a randomised controlled trial of tai chi classes versus wait list control for people with type 2 diabetes. Subjects were recruited through advertisements in local papers, a mailout to Diabetes Australia members and referrals from general practitioners. Subjects were eligible if they were aged 30 years or over, had a diagnosis of type 2 diabetes for at least 6 months, had a HbA1c of >7% and were able to attend tai chi classes twice per week for 6 months. Subjects were excluded if they were unable to walk for 10 minutes unaided or if they already participated in regular exercise classes three or more times per week. All subjects gave written informed consent.

Once eligibility had been confirmed, subjects were randomised to either tai chi or wait list control using a centralised computer generated allocation method. Those randomised to tai chi attended two 1 hour classes per week for 3 months and then once per week for a further 3 months. Those randomised to wait list were provided with vouchers for tai chi classes to use at the end of the study and were allowed to continue their usual exercise during the wait list period. The tai chi program for this study was based on 'yang and sun style 20-form', which has been designed for people with diabetes.[18]

Subjects were assessed at baseline and at completion of the study by either an exercise physiologist or trained nurse, both blinded to the treatment allocation. The measurements included fasting blood tests for glucose; HbA1c; Homeostasis Model Assessment (HOMA), which is a measure of insulin resistance; total cholesterol and triglycerides; height; weight; BP; resting heart rate; waist and hip circumference; balance; and a 6 m walking test. Patients also completed the SF-36 questionnaire.

The primary outcome measures were a reduction in HbA1c and mean systolic BP compared to baseline. Assuming that the effect of tai chi was to reduce HbA1c by 11% and systolic BP by 15 mmHg,[19] a sample of 40 subjects in each group would have 0.9 power to detect a significant difference (p=0.05, two sided). Paired t-test was used to compare the differences between baseline and follow up. All data were analysed using SPSS for Windows (version 15.0.1).

Table 1. Baseline characteristics of patients randomised in the tai chi for diabetes trial

	Control (n=25)	Tai chi (n=28)
Mean (SD) age	60.7 (12.2)	63.2 (8.6)
Female	16 (64%)	13 (46%)
Diabetes >10 years	9 (36%)	13 (46.4%)
Insulin requiring	5 (20%)	9 (32%)
Smoker	2 (8%)	4 (14.3%)
Regular exercise >3 days per week	7 (28%)	17 (60.7%)
Mean (SD) heart rate (beats/min)	78.7 (10.8)	76.3 (9.9)
Mean (SD) systolic BP (mmHg)	141.0 (25.5)	127.0 (17.6)
Mean (SD) diastolic BP (mmHg)	80.2 (11.4)	76.5 (8.7)
Mean (SD) BMI (kg/m^2)	32.0 (6.3)	32.4 (6.7)
Mean (SD) HbA1c	9.0 (1.4%)	8.5 (1.2%)
Mean (SD) HOMA	7.5 (6.5)	7.6 (9.5)
Mean (SD) total cholesterol (mmol/L)	4.5 (1.2)	4.3 (1.8)
Mean (SD) triglycerides (mmol/L)	1.8 (1.2)	1.7 (1.3)
Withdrew from study	3 (12%)	7 (25%)

Results

There were 272 subjects who replied to the advertisements and underwent telephone screening. Eighty-nine subjects were excluded at this stage because their HbA1c was <7%, 51 subjects were unable to attend the classes at the times scheduled because of work or they were already taking part in regular exercise classes, 65 were excluded for other reasons such as pending HbA1c results or not returning calls. A total of 67 patients attended for baseline assessment and of these seven were excluded because their HbA1c

Table 2. Results of paired t-test to compare the difference between tai chi and control

	Control			Tai chi			*p* value
	n	Baseline	Follow up	n	Baseline	Follow up	
Diastolic BP	22	81.8 + 11.0	80.4 + 11.8	24	77.7 + 9.7	77.5 + 10.7	0.68
Systolic BP	22	140 + 6.1	141 + 22.1	24	129.3 + 17.9	135.1 + 22.5	0.45
HbA1c	20	8.7 + 1.3	8.5 + 1.5	24	8.4 + 1.2	8.1 + 1.4	0.86
HOMA	19	7.7 + 6.4	10.1 + 8.9	20	5.7 + 4.3	7.1 + 5.8	0.53
Total cholesterol	24	4.7 + 0.8	3.5 + 2.0	27	4.5 + 1.7	3.1 + 1.8	0.79
Triglyceride	24	1.9 + 1.2	1.7 + 1.9	27	1.8 + 1.3	1.4 + 1.6	0.60
6 m walk	22	5.2 + 1.1	10.7 + 25.5	24	5.1 + 0.7	5.7 + 1.6	0.34

Table 3. Summary of SF-36 item health survey (V. 1.0) mean scale scores for control and tai chi group at baseline and follow up

Scale		Control (n=22) Mean score (SD)	Tai chi (n=24) Mean score (SD)
Physical functioning	Baseline	73.41 (23.78)	63.49 (27.14)
	Follow up	70.31 (26.56)	72.92 (21.61)
Role limitations due to physical health	Baseline	69.05 (41.01)	55.21 (45.43)
	Follow up	67.86 (38.85)	70.83 (38.78)†
Role limitations due to emotional health	Baseline	81.06 (26.38)	69.44 (40.43)
	Follow up	81.82 (36.70)	79.17 (35.18)
Energy/fatigue	Baseline	56.67 (17.42)	51.67 (23.62)
	Follow up	56.67 (18.80)	55.42 (21.60)
Emotional wellbeing	Baseline	80.38 (11.02)	73.92 (19.63)
	Follow up	78.95 (10.68)	76.17 (15.89)
Social functioning	Baseline	81.25 (22.74)	75.00 (29.02)
	Follow up	83.52 (21.27)	86.46 (21.15)‡
Pain	Baseline	73.30 (27.66)	64.27 (30.48)
	Follow up	71.93 (28.25)	65.73 (27.28)
General health	Baseline	54.32 (17.55)	48.98 (24.55)
	Follow up	56.59 (19.06)	55.95 (25.37)*

† = p=0.04, ‡ = p=0.024, * = p=0.044

was <7.0% and a further seven because they refused to have blood tests. A total of 53 patients were randomised to the study. There were 10 patients who withdrew from the study because of illness (5) or time commitments (2). Three patients withdrew toward the end of the study but returned for final blood tests and were included in the analysis. The baseline characteristics of the 53 patients randomised to the study are described in *Table 1*.

There was a reduction in HbA1c in both groups between baseline and follow up but this was not statistically different between those randomised to tai chi or to control. There was a statistically significant difference between baseline and follow up for total cholesterol for the tai chi group (p=0.03) but the difference between the two groups was not significant (p=0.79) (*Table 2*). There was a significant improvement in three of the subscales of the SF-36, role due to physical function (p=0.04), social function (p=0.024), and general health (p=0.044) with tai chi from baseline to follow up but again the difference between the two groups was not significant (*Table 3*).

Discussion

This is the first community based randomised controlled trial to assess the effectiveness of tai chi for type 2 diabetes compared to wait list control. There was no statistically significant improvement in metabolic control or cardiovascular risk after the 6 month period in the tai chi compared to the wait list control group. However, an improvement was observed in physical and social functioning in the tai chi group from baseline to follow up.

Both the tai chi and control groups demonstrated reductions in HbA1c, diastolic BP, cholesterol and triglycerides between baseline and follow up but the difference between the two groups was not significant. Several reasons may explain why this might have occurred. The number of patients recruited to the study was smaller than the required sample size and a larger study is needed to exclude a type 2 error. Some of the subjects were excluded because they were already participating in exercise programs or had an HbA1c <7%. The enrolled subjects were not stratified according to their baseline exercise level at the randomisation process. The intensity and duration of the tai chi may not have been optimal to show a demonstrable change. The expected effect of tai chi to reduce HbA1c by 11% and systolic BP by 15 mmHg may have been too high.

There are data to indicate that exercise of at least moderate intensity (>20 metabolic equivalent levels [MET] per hour per week, which is a measure of energy expenditure during exercise) is necessary to improve cardiovascular outcomes.[20] There is also evidence that it is difficult to engage people with chronic diseases such as diabetes in such intense exercise programs.[21] Tai chi is a gentler form of exercise and the intensity or duration of the exercise may not have been enough to demonstrate significant change. A recent study by Yeh et al[22] reported a significant decrease in HbA1c between pre- and post-exercise measurements but there was no control comparison group. In another study, Orr et al[23] reported a slight but not significant decrease in HbA1c following tai chi. These studies differed from this study with

respect to their duration and number of hours of tai chi per week. In both our study and the Orr study, tai chi classes were scheduled twice a week but three times a week for only 12 weeks in the Yeh study and there was no control group.

Despite the inconclusive findings of our study, we believe that tai chi, with its relatively low cost, easy accessibility and high adherence rate may still be a useful adjunct for the treatment of type 2 diabetes. The improvements observed in the subscales of the SF-36 indicate that tai chi may have wider health benefits for people with type 2 diabetes and are consistent with previous reports of the benefits of tai chi in people with chronic disease.[13] Tai chi as provided in this study may be a useful introduction to greater physical activity. However, longer duration or increased number of tai chi sessions per week may be required to demonstrate significant reductions in metabolic or cardiovascular parameters.

Conflict of interest: none declared.

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