Contents lists available at ScienceDirect

Patient Education and Counseling

journal homepage: www.elsevier.com/locate/pateducou

Mini-review

An updated meta-analysis to assess the effectiveness of psychological interventions delivered by psychological specialists and generalist clinicians on glycaemic control and on psychological status

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ARTICLE INFO

Article history:

Received 9 June 2008

Received in revised form 11 August 2008

Accepted 30 August 2008

Available online xxx

Keywords:

Diabetes

Psychological interventions

Glycaemic control

HbA_{1c}

Psychological specialist

Generalist clinicians

Health care delivery

ABSTRACT

Objective: To update a meta-analysis and determine the effectiveness of psychological interventions on glycaemic control measured by HbA_{1c} and psychological status in type 2 diabetes and to compare effects when interventions are delivered by generalist clinicians compared to psychological specialists.

Methods: We used the original review protocol and searched the Cochrane central register of controlled trials, Medline, Embase, PsychLIT, and Google Scholar from February 2003 (end of previous review) to March 2007. We extracted data on the participants, interventions, delivery methods, comparison groups and outcome measures.

Results: 35 trials were reviewed and meta-analysis of 19 trials ($n = 1431$), reporting HbA_{1c} found a reduction in HbA_{1c} by 0.54% (−0.32; 95% CI: −0.47 to −0.16). In nine trials ($n = 832$) interventions were delivered by diabetes or general clinicians reducing HbA_{1c} by 0.51% (−0.27; 95% CI: −0.50 to 0.04). In nine trials, interventions ($n = 561$) were delivered by psychological specialists reducing HbA_{1c} by 0.57% (−0.36; 95% CI: −0.61 to 0.12). Meta-analysis of 13 trials reporting psychological status found psychological status to be lower in the intervention groups −0.56 (95% CI: 1.00 to −0.13). Trial quality for the majority of studies remained poor.

Conclusion: Our findings suggest that psychological and general clinicians are similarly effective in delivering psychological interventions, however, effect sizes for all clinicians have reduced since the earlier review.

Practice implications: Psychological training opportunities for generalist clinicians could lead to wider availability of effective psychological care.

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1. Introduction

1.1. Background

Diabetes is a complex metabolic condition in which the patient has a life-long responsibility for managing their condition. The first aim of diabetes management is the control of blood glucose levels, usually termed glycaemic control, which is measured by an HbA_{1c} blood test. HbA_{1c} measures the amount of circulating glucose in

the blood over a 120-day period. The aim of treatment and patient management is to achieve HbA_{1c} levels $\leq 6.5\%$ and the UKPDS [1] established that every 1% reduction in HbA_{1c} towards this goal carries a 14–37% reduction in serious diabetes-related complications such as heart disease, blindness and kidney disease [1]. In order to achieve optimum glycaemic control people living with diabetes have to regulate their behaviour on a daily basis. The behavioural challenges imposed by close attention to diet, medication regimens including subcutaneous insulin injections, exercise, weight management, self-monitoring of daily blood glucose levels and foot care are burdensome and have social and emotional consequences [2]. In addition to this, specific psychological problems including depressive disorders [3,4] and eating disorders [5] can manifest themselves through poor glycaemic control thus giving rise to further complications.

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Abbreviations: HbA_{1c}, glycaemic control; CBT, cognitive behaviour therapy; RCTs, randomised controlled trials; GPs, general practitioners; I^2 , Higgins I squared test; NS, not stated; D, diet; T, tablets; I, insulin; TTM, transtheoretical model of change.

1.2. Previous review

Ismail et al. [2] published a systematic review and meta-analysis in 2004 which identified the potential clinical and psychological benefits of offering psychological interventions to patients with type 2 diabetes. The review [2] incorporated interventions comprising the most commonly used psychotherapeutic models used in health-care settings. They included supportive or counselling therapy (including motivational interviewing and non-directive counselling), brief psychodynamic therapy, interpersonal psychotherapy and cognitive behaviour therapy and its associated techniques including contract setting, goal setting, problem solving, activity scheduling, stress management and relaxation.

Ismail et al. [2] identified 25 trials and observed significant reductions in HbA_{1c} of 1%, similar to that of the UKPDS [1] but notably and unlike the UKPDS, these were achieved by non-pharmacological means. Psychological distress was also reduced. The findings suggest that psychological therapies may be a useful adjunct to current routine diabetes care.

However, despite the apparent benefits of psychological care in diabetes [6–8], there remains a severe shortage of psychological specialists within mainstream health care preventing access for the majority of patients [9]. Ismail et al.'s [2] review included a number of trials in which the psychological intervention had been delivered by a physician or nurse (generalist clinicians) compared to delivery by a professional with specialist training in psychology (specialist). It is not clear whether the discipline and training of the therapist makes a difference to outcome. If psychological interventions can be effectively delivered by generalist clinicians, access to this care becomes more possible for patients.

1.3. Goals of the current study

This paper reports an update to the Ismail et al. [2] review and meta-analysis to establish whether the 1% reduction in HbA_{1c} has been maintained and to compare the impact of the intervention on glycaemic control and psychological status if the intervention is delivered by generalist clinicians compared to psychological specialists. Additionally, the previous review was subjected to some criticism upon publication and there was concern that the small sample sizes of included trials and poor trial quality had resulted in an overestimation of treatment effect [10,11]. We will report on whether the quality of psychological intervention trials has improved subsequent to the more recent common acceptance of the CONSORT trial quality criteria [12].

2. Methods

2.1. Selection criteria

The review follows the original protocol [13] and eligible studies were randomised control trials (RCT's) utilising a psychological intervention in adults with type 2 diabetes. Studies describing psychological therapies were included as were psycho-educational studies with a detailed psychological component and where the intervention balance was more towards the psychological component. We classified the interventions based on the psychological techniques used, mode of delivery and type of control employed. Interventions not clearly describing the psychological components were omitted.

Specialist psychological therapists were defined as professionals whose speciality was in the psychological care of people and included psychologists, psychiatrists, psychotherapists and counsellors. Generalist clinicians were defined as professionals

whose speciality was in the provision of general and specialist diabetes clinical care and included GPs, diabetes physicians, nurses, dietitians and occupational therapists. Outcome measures were glycaemic control measured by HbA_{1c} and measures of psychological status (anxiety and/or depression).

2.2. Search strategy

Using the Cochrane collaboration's optimum search strategy for randomised controlled trials the search co-ordinator from the earlier review updated the search from February 2003 to March 2007. Details of the search strategy are published elsewhere [13].

2.3. Study selection

Two authors (JS & KW) independently assessed the abstracts for inclusion in the review and inter-rater reliability was reported using Cohen's kappa (κ) [14]. We included abstracts of papers where a controlled trial of a psychological intervention for type 2 diabetes was described. Where differences between raters, or ambiguity occurred, the full papers were retrieved and disagreements were resolved through dialogue. Three authors (JS, RA and KW) independently reviewed the full text papers for inclusion.

2.4. Data extraction

JS & RA independently extracted the data of included studies using the original extraction form. Papers written in languages other than English underwent data-extraction by a native-speaking-registered translator and RA. For studies comparing more than one intervention group we included the most intense psychologically underpinned intervention for analysis.

We recorded age of participants, numbers at baseline and follow-up, study country of origin and setting (including the format, type and duration of intervention), delivery specialist, results and we assessed the study quality. Where data was missing, we contacted the original authors for clarification in order to include in the review.

2.5. Statistical analysis

Data was entered into SPSS (version 14.0) and the meta-analysis was carried out using the metan command in STATA (intercooled version 9.0).

2.5.1. Meta-analysis and heterogeneity

When combining data in meta-analysis, no two studies are likely to be identical and heterogeneity is the variation that exists between the individual studies.

Clinical heterogeneity is described as variability amongst the participants, the interventions and study outcomes measures. Methodological heterogeneity is described as the variability in study design and risk of bias. Statistical heterogeneity is the consequence of clinical or methodological heterogeneity or both and we refer to this simply as heterogeneity. If the clinical and methodological heterogeneity was considered minimal in the studies, then a meta-analysis was deemed possible. The method for detecting heterogeneity in the studies was planned through (a) observation of the forest plot to examine how well the confidence intervals overlay; (b) performance of a Chi-squared (χ^2) test with a p -value of >0.10 [15] and (c) by quantifying the effect of heterogeneity using I^2 [16]. A small p -value from the χ^2 test is used to indicate evidence of heterogeneity. However, the statistical power of this test is limited in the presence of few studies. For this reason, a p -value of less than 0.10 is often used to indicate

heterogeneity rather than the conventional cut-off point of $p = 0.05$. The I^2 test is a useful adjunct to assess heterogeneity and provides a quantified measure of consistency between the trials, where values of 25%, 50% and 75% represent low, moderate and high levels of heterogeneity respectively [16].

2.5.2. Meta-analytical procedures

Meta-analysis was deemed appropriate if there were five or more trials with minimal heterogeneity for inclusion which measure the same outcome. The two outcome measures used in our meta-analysis were HbA_{1c} and measures of psychological distress.

The mean and standard deviation at baseline and follow-up were extracted for each intervention and each outcome. The mean change from baseline (follow-up–baseline) was extracted for each outcome and this provided the within-group mean. The pooled standard deviations for the mean change scores were obtained and provided the within-group standard deviation. If this standard deviation was missing, then the square root of the baseline and follow-up variance was obtained. This approach is based on the assumption that the correlation between the baseline and follow-up outcome values is 0.5.

2.5.3. Effect size

The difference in the mean change values between the two interventions (treatment–control) divided by the pooled standard deviation for this difference provided the estimate of the effect size. This was obtained for each assessment, which was then used in the meta-analysis. The effect sizes or the standardised mean difference method expresses the size of the treatment in each trial relative to the variability observed in that trial. The method allows different measures of the same outcome to be combined because different methods for measuring the outcomes were used.

2.5.4. Random effect and fixed effect models

In order to obtain a common effect across all the studies, fixed effects and random effects meta-analysis models were computed and the results compared. With fixed effects models all of the studies that are examined as a whole are considered to have been conducted under similar conditions with similar subjects. The random effects models generally produce wider confidence intervals and allow the study outcomes to vary in a normal distribution between studies. As with the original review [2] we anticipated some heterogeneity and use of the random effects model enabled us to minimise the impact of “background noise” presented by individual studies.

2.5.5. Transformation of effect sizes

For the outcome of HbA_{1c} we converted the estimated pooled standardised effect size into absolute units by multiplying the estimate by the pooled S.D. of all the studies included in the meta-analysis for each outcome. In the case where different studies gave different results, reasons why effects differed across studies were assessed using meta-regression analysis (using metareg in STATA (version 9)). Both these techniques are used to see if particular characteristics of studies are related to the sizes of the treatment effect. The number of sessions and duration of therapy, which are deemed proxy measures of intensity and duration of follow-up were used as potential covariates in a regression meta-analysis.

2.6. Quality assessment

Quality assessment criteria developed by Schulz et al. [17] and Jadad et al. [18] was used to assess for selection, attrition and detection bias.

2.7. Publication bias

Publication bias is the phenomenon in which (i) positive results have a better chance of being published, (ii) are published in journals with higher impact factors (and are more likely to be retrieved in medical literature searches) and (iii) are published faster. Publication bias was estimated by using a funnel plot for the treatment effect (using the treatment difference) and its standard error [19]. In the absence of publication bias, we would expect less precise studies (small sample size, duration, follow-up) to be more affected by chance alone, thus widely scattered from the pooled estimate. As studies get larger with more events, we expect them to be closer to the pooled estimate with a resulting triangular shape (or funnel), split by a line representing the pooled estimate of the meta-analysis. Formally, the Begg's adjusted rank correlation test was used to assess if there is a significant correlation between the standardised effect estimates and their variances [20].

2.8. Sensitivity analysis

Sensitivity analysis was performed using fixed and random effects models, by excluding borderline studies, by excluding studies using a less intensive psychological therapy as controls, by excluding studies with clinical sub-groups and by comparing poor quality studies with the higher quality studies.

2.9. Role of the funding source

The funders of the study had no involvement with any aspect of the study, including the decision to submit this report for publication.

3. Results

3.1. Description of new trials

The 2003–2007 searches identified 3218 new studies from which 48 full texts were selected for further extraction with a substantial level of agreement between the reviewers ($\kappa = 0.67$) [14]. Fig. 1 shows the flow of original and newly identified studies considered for the review. Ten new trials which were published after the CONSORT statement [12] were identified for inclusion in the systematic review.

3.1.1. Study quality

One study was rated as quality B [21] and nine studies rated as C [22–30].

3.1.2. Psychological therapies used

Seven studies utilised cognitive behaviour therapy [22–28], two trials utilised counselling techniques [29,30] and one trial utilised psychotherapy [21].

3.1.3. Intervention delivery specialist

Five of these trials were delivered by generalists [23,25,26,30,31], three were delivered by psychological specialists [21,24,27] and two did not report the specialist [22,28].

3.1.4. Intervention format

The mean intervention duration was 18.3 (S.D. 11.9) weeks. The majority of studies were delivered in a 1:1 format [22,23,25,26–28,30,31] and two were delivered in a combined group and 1:1 format [21,24].

Table 1

Characteristics of studies included in the systematic review of randomised controlled trials incorporating psychological interventions for patients with type 2 diabetes.

Year, country, reference	Number of participants recruited/at follow-up	Mean age (S.D. or range) (years)	Mean (S.D.) % glycated haemoglobin at baseline	Clinical sub-group (type of treatment)	Mean (S.D. or range) duration of diabetes (years)	Model and duration of therapy in intervention group	Regimen in intervention group and speciality of therapist	Model and duration of therapy in control group	Regimen in control group and speciality of therapist	Follow-up months	Quality
1983, Canada, Rabkin	40/40	53–9 (2–0)	NS	Sub-optimum glycaemic control (D, T)	NS	Group CBT for 6 weeks	6 behaviour modification sessions by nutritionist	Individual education for 6 weeks	2 individual dietary counselling sessions by nutritionist	3	C
1985, USA, Wing	53/50	55–1 (7–3)	9.33 (0.3)	Obese (D, T)	5–9 (NS)	Group CBT for 16 weeks	16 behaviour modification sessions by psychologist and nutritionist	Group education for 16 weeks	4 standard education sessions by psychologist and nutritionist	4	C
1986, USA, Hartwell	76/76	NS	8.7 (2.7)	Sub-optimum glycaemic control (D, T)	NS	Group CBT for 10 weeks	14 CBT sessions by dietician and exercise leader	Group education for 10 weeks	10 traditional education sessions by multidisciplinary diabetes team	6	C
1986, USA, White	41/32	61–6 (6–4)	11.3 (3.1)	Men, obese, sub-optimum glycaemic control (D, T, I)	12–6 (11–4)	Group CBT for 6 months	16 group management sessions by psychologist	Group education for 6 months	16 advice/education sessions by nurse and dietician	6	C
1987, USA, Heitzmann	46/46	52–9 (12–1)	11.3 (2.3)	General (D, T, I)	NS	Group and individual CBT for 7 weeks	7 group and 9 individual CBT sessions; speciality not specified	Group CBT (duration not specified)	Minimal relaxation training; speciality not specified	6*	B
1987, Spain, Rodriguez	11/11	60–7 (51–70)	NS	General (treatments not specified)	4–3 (3–7)	Individual CBT and education for 5 weeks	3 CBT sessions and 2 education sessions by psychologist	Individual education for 5 weeks	2 education sessions; speciality not specified	2	C
1990, Australia, Campbell	62/61	58–5 (9–0)	11.6 (1.9)	Sub-optimum glycaemic control obese (D, T, I)	7–5 (7–0)	Group counselling for 11 weeks	Cognitive motivational therapy (number of sessions NS) by physician, dietician and psychologist	Group education (duration not specified)	3 education sessions; speciality not specified	6	B
1991, USA, Wing	49/43	52–5 (7–5)	9.9 (2.2)	Obese (D, T, I)	NS	Group CBT and couple therapy for 10 weeks	16 behavioural modification and couple therapy sessions by multidisciplinary team (project physician and trained nutritionist reported)	Group CBT for 10 weeks	16 behavioural modification sessions by multidisciplinary team	5	C
1992, USA, D'Eramo	54/34	56–0 (8–1)	11.1 (2.8)	Obese (D, T)	NS	Group education and individual counselling for 11 weeks	11 intensive group education and 2 individual counselling sessions by nurse	Education for 1 week	1 minimal education session by nurse	6	C
1993, USA, Boehm	156/135	58–0 (11–3)	NS	General (D, T, I)	NS	Individual CBT (duration not specified)	Behaviour modification delivered by clinical nurse specialist (number of sessions NS)	Usual care	Regimen not described; speciality not specified	NS	C
1993, USA, Lane	38/38	NS	10.3 (2.3)	Sub-optimum glycaemic control (D, T)	NS	Individual CBT for 8 weeks and intensive diabetes care for 12 months	8 relaxation training sessions and intensive diabetes care; speciality not specified	Intensive diabetes care for 12 months	Intensive diabetes education and clinical care; speciality not specified	6	B
1996, Australia, Campbell	118/60	59–5 (10–2)	12.6 (4.3)	General (D, T)	0–4 (0–1)	Individual CBT for 12 months	6 CBT sessions by nurse educator	Group education for 2 weeks	2 minimal education sessions by nurse educator and dietician	6	B

Table 1 (Continued)

Year, country, reference	Number of participants recruited/at follow-up	Mean age (S.D. or range) (years)	Mean (S.D.) % glycated haemoglobin at baseline	Clinical sub-group (type of treatment)	Mean (S.D. or range) duration of diabetes (years)	Model and duration of therapy in intervention group	Regimen in intervention group and speciality of therapist	Model and duration of therapy in control group	Regimen in control group and speciality of therapist	Follow-up months	Quality
1997, USA, Aikens	22/22	61–0 (10–2)	11.0 (1.9)	General (D, T, I)	11–0 (9–0)	Group CBT for 8 weeks	6 relaxation training sessions by psychologist	Usual care	Routine medical care; speciality not specified	4	C
1997, Australia, Henry	19/19	60–0 (47–74)	10.7 (1.9)	Sub-optimum glycaemic control, stress/anxiety (D, T, I)	6–4 (1–5–23–0)	Group CBT for 6 weeks	6 stress management sessions by psychologist	Waiting list	Usual practice by physician	2–25	C
1997, USA, Jablon	20/20	58–9 (7–7)	6.5 (1.8)	Sub-optimum glycaemic control (D, T)	7–9 (8–7)	Individual CBT for 4 weeks	8 relaxation therapy sessions by psycho-physiologist	Waiting list	None; speciality not specified	1	C
1997, USA, Smith	22/16	62–4 (7–0)	10.3 (2.2)	Women, obese (D, T)	6–7 (5–4)	Group CBT and individual counselling for 4 months	16 group behaviour modification by nutritionist, exercise psychologist, and psychologist and 3 individual sessions by psychologist.	Group CBT for 4 months	16 group behaviour modification by nutritionist, exercise psychologist, and psychologist	4	C
1998, USA, Lustman	51/42	54–8 (10–1)	10.3 (3.4)	Depression (D, T, I)	8–8 (9–5)	Group CBT and education for 10 weeks	30 CBT sessions by psychologist and 20 education sessions by diabetes educator	Group education for 10 weeks	20 education sessions by diabetes educator	6*	A
1999, USA, Ridgeway	38/38	63–5 NS	12.3 (2.6)	General (D, T, I)	11–5 (NS)	Group CBT and education for 6 months	6 behaviour modification sessions and education by diabetes educators	Usual care	Usual office visits by family physicians	6	B
2001, China, Huang	59/59	NS	9.9 (2.1)	Depression (treatments not specified)	NS	Group counselling for 3 months	24 supportive psychotherapy sessions by psychiatrist	Usual care	Conventional diabetes care; speciality not specified	3	C
2001, USA, McKay	78/68	52–3 (NS)	NS	Sedentary (D, T, I)	NS	Individual CBT for 8 weeks	Internet-based physical activity intervention by occupational therapist	Individual education (duration not specified)	Internet-based education; speciality not specified	2	C
2001, China, Zhu	59/56	57–4 (9–4)	NS	General (treatments not specified)	7–4 (5–4)	Individual CBT for 1 month	Relaxation training by psychiatrist (number of sessions not given)	Usual care (duration not specified)	Conventional diabetes care; speciality not specified	1	C
2002, Australia, Kenardy	34/32	55–0 (10–5)	7.5 (1.5)	Binge-eating (D, T, I)	3–2 (5–7)	Group CBT for 10 weeks	10 CBT sessions by psychologist	Group counselling for 10 weeks	10 non-prescriptive therapy sessions by psychologist	2–5	B
2002, USA, Surwit	108/72	57–4 (10–9)	7.8 (1.8)	General (D, T)	NS	Group CBT and education for 2 months	5 education and stress management training sessions; speciality not specified	Group education for 2 months	5 education sessions; speciality not specified	12	C
2002, Japan, Tsujiuchi	36/26	62–2 (8–2)	8.2 (1.7)	General (treatments not specified)	NS	Group CBT for 4 months	16 Qi-gong relaxation training sessions by Chinese Qi-gong doctor (Ph.D. in medicine)	Waiting list	Conventional diabetes care; speciality not specified	4	C
2003, China, Zeng	108/106	56.0 (NS)	10.5 (NS)	General (D, T, I)	5.5 (2–11)	Group and single CBT and education for 6 months	24 sessions (30–60 min) of supportive psychotherapy, relaxation and education Combination of psychotherapist & clinician	Individual education on diet & medication	Diet control and usual medication delivered by dietician	6	C

Table 1 (Continued)

Year, country, reference	Number of participants recruited/at follow-up	Mean age (S.D. or range) (years)	Mean (S.D.) % glycated haemoglobin at baseline	Clinical sub-group (type of treatment)	Mean (S.D. or range) duration of diabetes (years)	Model and duration of therapy in intervention group	Regimen in intervention group and speciality of therapist	Model and duration of therapy in control group	Regimen in control group and speciality of therapist	Follow-up months	Quality
2004, UK, Clark	100/94	59.5 (40–70)	8.4 (1.6)	Sub-optimum glycaemic control (D, T, I)	8.0 (NS)	Individual CBT for 7 weeks	4 Motivational interviewing sessions and goal setting by psychologist	Usual care; not described	Usual diabetes care; speciality not specified	3	B
2004, UK, Kirk	70/59	57.6 (±7.9)	8.7 (NS)	Sedentary (D, T, I)	6.0 (NS)	Individual CBT for 36 weeks	2 (30 min) face-to-face consultations & 4 telephone sessions by a trained exercise science graduate (research assistant: single format)	Usual care and standard DUK leaflets	Regimen not described; speciality not specified	6	C
2004, China, Huang	120/105	57 (±8.5)	10.6 (±1.47)	General with no somatic/mental disorders (D, T, I)	5.75 (±2.2)	Individual CBT and counselling and group education for 24 weeks	12 mixed sessions of health education (in groups) and individual psychotherapy and counselling by psychotherapist and clinical therapist	Usual care and medication for 6 months, not described	Individual diet and exercise advice; speciality not specified	6	C
2004, USA, Whittemore	53/49	57.6 (±10.9)	7.7 (±1.3)	Women with no end stage disease (D, T, I)	2.7 (±3.0)	Individual CBT and education for 6 months	6 nurse-coaching sessions & 2 telephone support sessions over 6 months by registered nurse	Usual care on waiting list (single format)	Regular appointments with primary care providers at 3–4-month intervals; nurses, internists, family practice specialist & endocrinologist	6	C
2005, China, Bing	300/300	52.85 (±17.2)	9.6 (±1.75)	General (D, T, I)	5.0 (±3.63)	Group education (patients & families) and individual CBT for 6 months.	24 individual relaxation sessions over 6 months and 24 educational sessions over 6 months with doctor, nurse and dieticians	Usual care and medication for 6 months (single format)	Conventional diabetes care; speciality not specified	6	C
2005, China, Zhao	80/80	67.3 (±4.53)	NS	General (D, T, I) with 2nd & 3rd degree diabetic retinopathy	NS	Individual CBT for 28 days	8 telephone consultations over 28 days and patients to utilise relaxation techniques twice a day (2 min × 30 min) for 28 days. Speciality not specified	Basic regular medical treatment, not described (single format)	Conventional diabetes care; speciality not specified	1	C
2005, USA, McGinnis	39/30	51.5 (NS)	7.2 (NS)	General (D, T, I)	NS	Individual CBT for 10 weeks	10 sessions of bio-feedback & relaxation. Speciality not specified	One-to-one diabetes education sessions with leaflets provided by registered nurse	3 (60–75 min each) sessions held 3/4 weeks apart; speciality not specified	2	C
2006, Germany, Siebolds	250/223	59.6 (45–70)	8.4 (NS)	General (D, T)	5.33 (NS)	Individual standardised counselling and the use of food and blood glucose diaries	Four individual counselling sessions provided by physician and nurse over 24 weeks counselling algorithm focussed on self-perception, self-reflection and self-regulation	Individual non-standardised advice on diet and lifestyle.	Speciality not specified, details of advice not specified, spread over 4 sessions in 24 weeks.	6	C

Table 1 (Continued)

Year, country, reference	Number of participants recruited/at follow-up	Mean age (S.D.) or (range) (years)	Mean (S.D.) % glycated haemoglobin at baseline	Clinical subgroup (type of treatment)	Mean (S.D. or range) duration of diabetes (years)	Model and duration of therapy in intervention group	Regimen in intervention group and speciality of therapist	Model and duration of therapy in control group	Regimen in control group and speciality of therapist	Follow-up months	Quality
2006, China, Ma	67/67	44.5 (NS)	9.15 (NS)	Diagnosed at out-patient clinic and hospitalised (D, T, I)	4.6 (NS)	Single and group (family) psychotherapy for 6 weeks. Sessions included workshop discussions on education, diet, blood sugar and attitudes; music relaxation and behaviour remedy strategies.	6 individual (1 hr) sessions over 6 weeks delivered by psychologist	Individual usual care by medication for 6 weeks	Individual treatment (gliclazide, 80 mg three times daily). Speciality not specified	1.5	B
2007, UK, Jackson	40/34	60.2 (NS)	(NS)	General (D, T, I)	7.66 (NS)	Individual stage-based counselling on one occasion and education with Diabetes UK leaflet	1 (20–30 min) session conducted by a dietician trained in counselling on the TTM, motivational interviewing and written action planning.	Standard Diabetes UK exercise leaflet provided.	Not described and speciality not specified	1.5	C

NS = not stated, data missing; D = diet; T = tablets; I = insulin; CBT = cognitive behavioural therapy; TTM = transtheoretical model of change. *Change in HbA_{1c} was recorded from end of treatment to end of follow-up.

3.1.5. Participants

The mean time since diagnosis was 5.3 (S.D. 2.94) years and the mean sample size was 105.3 (S.D. 85.59).

3.1.6. Follow-up

The mean follow-up of interventions was 18.0 (S.D. 10.30) weeks.

These additional 10 trials were pooled with the previous 25 trials from the original review [2] resulting in a total of 35 trials (Table 1). Reasons for exclusion are shown in Fig. 1.

3.2. Description of included trials from original and new review

3.2.1. Sample size

The mean sample size of the 10 new trials was higher (105.3, S.D. 88.15) than the previous review (47.6, S.D. 27.5) and added 1053 (47%) more patients to the original 1190 patients (53%) to provide 2243 patients in total.

3.2.2. Study quality

Of the 35 trials one study was classified A for quality [31], 8 studies were classified as B [21,32–38] and the remaining 26 studies were classified C [22–31,39–55]. Four studies reported analysing the results by intention to treat [21,25,31,38].

3.2.3. Psychological therapies used

The majority of studies examined cognitive behaviour therapy [25,26,31,35–38,41,43,49,54] including strategies of relaxation [21–24,28,34,48,50,53–55], problem solving [26,42], contract setting [40,46], goal setting [52], self-monitoring of behaviours [32,39] and enlisting social support [44]. Seven studies used counselling techniques [27,30,32,33,45,47,51]. Four studies compared a more intensive psychological therapy with a control that was less intensive [32,37,44,51].

3.2.4. Intervention delivery specialist

Sixteen of the 35 trials were delivered by psychological specialists [21,24,27,31,33,37,38,40,42,43,47–51,53], 13 were delivered by generalists [23,25,26,30,31,35,36,39,41,44,45,52,55] and 6 did not report the specialist [22,28,32,34,46,54].

Fig. 1. QUORUM flow chart.

Fig. 2. Meta-analysis illustrating the standardised effects of psychological interventions on glycaemic control.

3.2.5. Intervention format

The mean duration of interventions was 13.7 (S.D. 11.06) weeks. Fourteen trials used a group format [31,33,36,37,39–42,44,48,49,51,54,55], 16 used a single format [21,22,25–28,30,31,34,35,38,43,46,50,52,53] and 5 used a combination [21,24,32,45,47]. Eleven of the 35 trials used an educational component in the intervention in addition to the psychological component [21,23,24,26,27,30,31,36,43,45,54].

3.2.6. Follow-up

The mean follow-up of interventions was 18.5 (S.D. 10.4) weeks.

3.2.7. Study location

Only 3 trials were UK-based [25,30,38] and 17 were undertaken in USA [26,28,31,32,34,36,40–42,44–48,50,52,54], 7 in China [21–24,27,51,53], 4 in Australia [33,35,39,49], 1 in Canada [39], 1 in Germany [31], 1 in Japan [55] and 1 in Spain [43]. Eight studies were translated into English (one was Spanish [43] and seven were Chinese [21–24,27,51,53]).

3.2.8. Intervention fidelity

The precise training the generalist HCPs received in delivering the psychological interventions was not described for the majority of studies. Only one of the trials delivered by the generalists described the training received [30]. None of the 35 trials reported quality assessment procedures to ensure intervention fidelity.

3.3. Meta-analysis

3.3.1. Glycaemic control

Seven new trials reported HbA_{1c} values as their primary outcome bringing the total to 20. One study was excluded from the meta-analysis due to missing data [28]. Sixteen trials reported baseline HbA_{1c} values for intervention and control arms at 9.53% (S.D. 1.59) and 9.66% (S.D. 1.67) respectively and three studies reported the mean difference between baseline and follow-up.

In total, 19 studies were meta-analysed, 14 of which reported improvements in HbA_{1c}, 4 reported deterioration and 1 showed no

difference (Fig. 2). With the random effects model, the pooled effect size for HbA_{1c} was -0.32 (95% CI: -0.47 to -0.16). The treatment effect in absolute units was a decrease of 0.54% (-0.83 to -0.23) in HbA_{1c} indicating an improvement in glycaemic control.

The χ^2 test for heterogeneity was significant ($\chi^2 = 32.29$; $df = 18$; $p = 0.020$) and I^2 test indicates below moderate heterogeneity (44%). There was no evidence of publication bias in the funnel plot (Fig. 3), the Egger's test or the Begg adjusted rank correlation test ($p = 0.438$ and $p = 0.400$ respectively).

There was no statistical association between HbA_{1c} and duration of follow-up (regression coefficient (β) = 0.01 (S.E. = 0.01), $p = 0.275$) or duration of therapy (regression coefficient = -0.009 (S.E. = 0.01), $p = 0.488$). However there was some evidence of an association between improvements in HbA_{1c} and increased number of sessions (regression coefficient = -0.04 (S.E. = 0.01), $p = 0.001$).

In sensitivity analysis, the exclusion of two studies that used less intensive psychological therapy as the control intervention,

Fig. 3. Funnel plot illustrating publication bias of psychological interventions on glycaemic control.

Fig. 4. Meta-analysis illustrating the standardised effects of psychological specialists delivering psychological interventions on glycaemic control.

resulted in a larger estimate of the pooled effect size (-0.54 [95% CI: -0.84 to -0.23]) equating to an absolute decrease of 0.65% (-0.94 to -0.36) in HbA_{1c}.

3.3.2. Psychotherapist/psychologist and generalists

Psychological specialists and generalist clinicians were involved in the delivery of the interventions and meta-analyses were carried out on these two sub-groups.

The χ^2 test for the psychological specialists showed evidence of heterogeneity ($\chi^2 = 14.92$; $df = 8$; $p = 0.061$), however the I^2 test illustrates below moderate heterogeneity (46%). Using the random effects model, the pooled standardised effect size estimate for HbA_{1c} was -0.36 (-0.61 to -0.12) (Fig. 4).

The χ^2 test for the generalist clinicians showed evidence of heterogeneity ($\chi^2 = 16.77$; $df = 8$; $p = 0.033$) and the I^2 test illustrated moderate risk of heterogeneity (52%). Using the random effects model, the pooled standardised effect size estimate for HbA_{1c} was -0.36 (-0.61 to -0.12) (Fig. 5).

The treatment effect in absolute units was a decrease of 0.57% (-1.02 to -0.13) in HbA_{1c} for the psychological specialists and a decrease of 0.51% (-1.00 to -0.01) in HbA_{1c} for the generalist clinicians.

3.3.3. Psychological status

Five new trials reported measures of psychological status as an outcome and these were included in the meta-analysis. Of these 13

Fig. 5. Meta-analysis illustrating the standardised effects of generalist clinicians delivering psychological interventions on glycaemic control.

Fig. 6. Meta-analysis of standardised change scores in psychological status.

trials in total, 7 were delivered by psychological specialists, 4 were delivered by generalist clinicians which prevented a sub-group analysis by delivery specialist. Two trials did not report the specialist.

The test of heterogeneity from the random effects model indicates that the studies are statistically different (χ^2 test of heterogeneity = 132.45; $df = 12$; $p < 0.001$). With the random effects model, the pooled effect size effect for psychological distress was -0.56 (95% CI: -1.00 to -0.13) (Fig. 6). The weighted mean difference was a decrease of 7.9 units (-12.7 to -3.15) in psychological status.

There was no publication bias (plot not shown; Begg's test: $p = 0.714$). There was evidence of statistical association between improvements in psychological status and increased duration of therapy (regression coefficient = -0.43 (S.E. = 0.03), $p < 0.001$), increased follow-up length (regression coefficient = 0.52 (S.E. = 0.08), $p < 0.001$) and increased number of sessions (regression coefficient = 0.15 (S.E. = 0.14), $p < 0.001$) with the exception of one trial [22].

4. Discussion and conclusion

4.1. Discussion

The current review identified 10 additional trials to add to the original review and in total 35 RCTs were included in the review. Meta-analysis of 19 trials of psychological interventions demonstrated a 0.54% reduction in HbA_{1c}. The psychological specialists delivered a 0.57% reduction in HbA_{1c} and the generalist clinicians a 0.51% reduction. The positive trend in increasing sample size was not concomitant with improvements in the reporting of potential biases and hence trial quality, which remained poor.

4.1.1. Strengths and weaknesses of the study

Permission from the original reviewers to use their Cochrane review protocol and the involvement of the original reviewers was

a study strength enabling consistency between the review procedures.

The level of heterogeneity was less than ideal in particular relation to the interventions and the degree of intervention fidelity but was satisfactory in relation to the outcome of HbA_{1c} and trial design. Pooled data from 13 trials measuring psychological distress reported a significant reduction in psychological distress in the intervention arms, however, nine different psychological measurement tools were used, three of which were Chinese. The variability in the tools and scales used to measure psychological distress between the studies are likely to introduce some methodological heterogeneity and the lack of a consistent scale between studies requires the reader to interpret these units with caution.

4.1.2. Strengths and weaknesses in relation to other studies

Our meta-analysis of trials assessing glycaemic control using measures of HbA_{1c} found a smaller effect size compared to the 1% reduction reported in the original review [2]. Consistent with the previous review [2], however, we did observe improvements in the overall effect (0.65% reduction) when two studies using a less intensive psychological therapy as controls were excluded [37,44]. Trial quality has not improved with later studies and therefore cannot account for the observed reduction in effect. It is possible that an increase in clinician consciousness regarding the impact of psychological factors on patients, may have resulted in greater levels of psychological care being experienced in the comparison groups of newer trials, thus partially accounting for the reduced effect size observed in our update. Additionally, the newer trials tended to be larger in sample size, longer in duration and follow-up and their smaller effect size had a more profound impact on the overall pooled difference.

Furthermore, we report a statistically significant association between effect size and the number of sessions in the intervention. It appears that features of intervention and trial design such as length of follow-up and duration of intervention may not be as important as the number of sessions provided. The association

between improved HbA_{1c} and an increase in the number of sessions is possibly related to repeated exposures providing ongoing social support resulting in enhanced patient concordance and outcomes [56].

The sub-group analysis of psychological specialists and generalist clinicians indicates that generalists may be similarly effective in delivering psychological interventions in reducing HbA_{1c}. This supports an earlier finding by Mojica et al. [57] reporting on the effectiveness of different health care providers, including generalist and psychological specialist, on smoking cessation interventions. Only one trial in our review reported the specific training received by the generalists [30], however we believe that the success achieved by the generalists may be attributed to the acquisition of additional knowledge, training and skills. The inconsistency in reporting the specific training received in most trials suggests the need for the inclusion of such data in future studies.

Nonetheless, the effectiveness observed here contributes to previous reviews suggesting that people with diabetes could benefit from receiving care from generalist clinicians and diabetes specialist professionals who have received training in delivering psychological care [58].

4.2. Conclusion

The reductions observed in HbA_{1c} are clinically significant in reducing microvascular and macrovascular complications [1]. Furthermore, there have been previous concerns regarding the potential benefits of psychological care in patients with long-standing poor glycaemic control [59] and our findings suggest that patients with long-standing sub-optimal control may benefit from psychological interventions.

The benefits of delivering psychological interventions for people with type 2 diabetes by generalist clinicians, with additional and as yet unspecified training, have been highlighted and this has the potential to make this care more widely available.

4.3. Future recommendations

To assess the degree of effectiveness between psychological care specialists and generalist clinicians there is a need to test differences in high quality fully powered randomised control trials in UK, including more studies delivered by generalists.

Only three of the trials in this review were conducted in UK and as such the generalisability of the findings should be interpreted with caution. Additionally, in future studies there is a need to describe the training provided to intervention delivery staff and recommendations are made to quality assure interventions to both understand and assess intervention fidelity by clinician and patient.

The use of multiple measures of psychological status introduced methodological heterogeneity into the review making interpretation of findings difficult. Researchers are urged to consider these issues in their design of RCTs and also to consider further work along the lines of Herrmans et al. [60] to compare the use and outcomes of different instruments in the same populations.

4.4. Practice implications

Psychological interventions appear to be effective in improving psychological distress and glycaemic control, however there is a shortage of psychological specialists within the NHS and psychological treatments are difficult to access for most patients living with diabetes.

The findings of this study suggest that with some additional training, diabetes and generalist clinicians have the potential to effectively deliver psychological interventions and improve patient outcomes. This implies that psychological care can be made more widely available to patients across health services if they do not have to depend on a service of psychological specialists in limited supply. This study supports the recommendations of both UK and international health policy (International Diabetes Federation) for the need to provide generalist clinicians with new skills in this area [9].

Acknowledgements

We would like to thank the following colleagues for their help in undertaking this review and preparing this manuscript, Chris Bridle, Khalida Ismail, Hilary Hearnshaw, Hugh McGuire and Chiu Wong.

Contributors: KI and KW developed the protocol and search strategy, JS devised and designed the study. JS, RA and KW undertook data-extraction. RL & RA undertook the analysis. RA, RL & JS co-wrote the initial drafts. All authors contributed to the final manuscript.

Funding: This study was funded by a grant from The Medical Research Council and JS had a post-doctoral research fellowship from the UK Department of Health NCCRC scheme.

Competing interests: None declared.

Ethical approval: Not required.

Provenance and peer review: Not commissioned; externally peer reviewed. I confirm all patient/personal identifiers have been removed or disguised so the patient/person(s) described are not identifiable and cannot be identified through the details of the story.

References

- [1] Stratton IM, Adler AI, Neil HA, Matthews DR, Manley SE, Cull CA, Hadden D, Turner RC, Holman RR. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (ukpds 35): prospective observational study. *Brit Med J* 2000;321:405–12.
- [2] Ismail K, Winkley K, Rabe-Hesketh S. Systematic review and meta-analysis of randomised controlled trials of psychological interventions to improve glycaemic control in patients with type 2 diabetes. *Lancet* 2004;363:1589–97.
- [3] Gavard JA, Lustman PJ, Clouse RE. Prevalence of depression in adults with diabetes: an epidemiological evaluation. *Diabetes Care* 1993;16:1167–78.
- [4] Lustman PJ, Griffith LS, Freedland KE, Clouse RE. The course of major depression in diabetes. *Gen Hosp Psychiat* 1997;19:138–43.
- [5] Herpertz S, Albus C, Lichtblau K, Kohle K, Mann K, Senf W. Relationship of weight and eating disorders in type 2 diabetic patients: a multicenter study. *Int J Eat Disorder* 2000;28:68–77.
- [6] Steed L, Cooke D, Newman S. A systematic review of psychosocial outcomes following education, self-management and psychological interventions in diabetes mellitus. *Patient Educ Couns* 2003;51:5–15.
- [7] Hampson SE, Skinner TC, Hart J, Storey L, Gage H, Foxcroft D, Kimber A, Shaw K, Walker J. Effects of educational and psychosocial interventions for adolescents with diabetes mellitus: a systematic review. *Health Technol Assess* 2001;5:1–79.
- [8] Winkley K, Landau S, Eisler I, Ismail K. Psychological interventions to improve glycaemic control in patients with type 1 diabetes: systematic review and meta-analysis of randomised controlled trials. *Brit Med J* 2006;333:65–8.
- [9] Roberts S. Department of health, working together for better diabetes care: National Health Service; 2007. http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_074702
- [10] Brailion A. Should we trust results of meta-analyses? *Lancet* 2004;364:1401–2. author reply 02–3.
- [11] Nicolucci A, Tognoni G. Should we trust results of meta-analyses? *Lancet* 2004;364:1401. author reply 02–3.
- [12] Moher D, Schulz KF, Altman DG. The consort statement: revised recommendations for improving the quality of reports of parallel-group randomised trials. *Lancet* 2001;357:1191–4.
- [13] Ismail K, McGuire H, Winkley K. Psychological interventions for improving glycaemic control in patients with diabetes mellitus. (Protocol) *Cochrane Database of Systematic Reviews* 2001. doi: 10.1002/14651858.CD003055.pub3. Art No: CD003055.
- [14] Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics* 1977;33:159–74.

- [15] Dickersin K, Berlin JA. Meta-analysis: state-of-the-science. *Epidemiol Rev* 1992;14:154–76.
- [16] Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *Brit Med J* 2003;327:557–60.
- [17] Schulz KF, Chalmers I, Hayes RJ, Altman DG. Empirical evidence of bias, dimensions of methodological quality associated with estimates of treatment effects in controlled trials. *J Am Med Assoc* 1995;273:408–12.
- [18] Jadad AR, Moore RA, Carroll D, Jenkinson C, Reynolds DJ, Gavaghan DJ, McQuay HJ. Assessing the quality of reports of randomized clinical trials: is blinding necessary? *Control Clin Trials* 1996;17:1–12.
- [19] Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. *Brit Med J* 1997;315:629–34.
- [20] Begg CB, Mazumdar M. Operating characteristics of a rank correlation test for publication bias. *Biometrics* 1994;50:1088–101.
- [21] Ma ZW, Li MX, Wang CS. Effects of comprehensive psycho-intervention on life quality and carbohydrate metabolism in patients with type 2 diabetes mellitus. *Zhongguo Linchuang Kangfu* 2006;10:15–7 [in Chinese].
- [22] Zhao L, Sun YJ, Liu QG, Huan MM, Wu J, Zhou L, Shen HJ, Jiang C. Intervention effects of music relaxation therapy on the quality of life in patients with diabetic retinopathy. *Zhongguo Linchuang Kangfu* 2005;9:50–3 [in Chinese].
- [23] Bing S, Bo B, Hai-ling S. Effects of diabetes education and psychological intervention on comprehensive treatment of type 2 diabetes. *Chin J Clin Psychol* 2005;13:483–5 [in Chinese].
- [24] Zeng Z, Ma L, Tang L, Luo G, Zhou H, Zhou L. Comprehensive intervention on diabetes mellitus. *Chin Ment Health J* 2003;17:253–5 [in Chinese].
- [25] Kirk A, Mutrie N, MacIntyre P, Fisher M. Effects of a 12-month activity counselling intervention on glycaemic control and on the status of cardiovascular risk factors in people with type 2 diabetes. *Diabetologia* 2004;47:821–32.
- [26] Whitemore R, Melkus GD, Sullivan A, Grey M. A nurse-coaching intervention for women with type 2 diabetes. *Diabetes Educator* 2004;30:795–804.
- [27] Huang FL, Ye JH, Huang F. Effect of mental intervention on type 2 diabetes: randomized controlled study. *Zhongguo Linchuang Kangfu* 2004;8:5795–8 [in Chinese].
- [28] McGinnis RA, McGrady A, Cox SA, Grower-Dowling KA. Biofeedback-assisted relaxation in type 2 diabetes. *Diabetes Care* 2005;28:2145–9.
- [29] Siebolds M, Gaedeke O, Schwedes U. Self-monitoring of blood glucose-psychological aspects relevant to changes in hba1c in type 2 diabetic patients treated with diet or diet plus oral antidiabetic medication. *Patient Educ Couns* 2006;62:104–10.
- [30] Jackson R, Asimakopoulou K, Scammell A. Assessment of the transtheoretical model as used by dietitians in promoting physical activity in people with type 2 diabetes. *J Hum Nutr Diet* 2007;20:27–36.
- [31] Lustman PJ, Griffith LS, Freedland KE, Kissel SS, Clouse RE. Cognitive behavior therapy for depression in type 2 diabetes mellitus: a randomized, controlled trial. *Ann Intern Med* 1998;129:613–21.
- [32] Heitzmann CA, Kaplan RM, Wilson DK, Sandler J. Sex differences in weight loss among adults with type ii diabetes mellitus. *J Behav Med* 1987;10:197–211.
- [33] Campbell LV, Barth R, Gosper JK, Jupp JJ, Simons LA, Chisholm DJ. Impact of intensive educational approach to dietary change in NIDDM. *Diabetes Care* 1990;13:841–7.
- [34] Lane JD, McCaskill CC, Ross SL, Feinglos MN, Surwit RS. Relaxation training for NIDDM: predicting who may benefit. *Diabetes Care* 1993;16:1087–94.
- [35] Campbell EM, Redman S, Moffitt PS, Sanson-Fisher RW. The relative effectiveness of educational and behavioral instruction programs for patients with NIDDM: a randomized trial. *Diabetes Educator* 1996;22:379–86.
- [36] Ridgeway NA, Harvill DR, Harvill LM, Falin TM, Forester GM, Gose OD. Improved control of type 2 diabetes mellitus: a practical education/behavior modification program in a primary care clinic. *Southern Med J* 1999;92:667–72.
- [37] Kenardy J, Mensch M, Bowen K, Green B, Walton J. Group therapy for binge eating in type 2 diabetes: a randomized trial. *Diabet Med* 2002;19:234–9.
- [38] Clark M, Hampson SE, Avery L, Simpson R. Effects of a tailored lifestyle self-management intervention in patients with type 2 diabetes. *Brit J Health Psych* 2004;9:365–79.
- [39] Rabkin SW, Boyko E, Wilson A, Streja DA. A randomized clinical trial comparing behavior modification and individual counseling in the nutritional therapy of non-insulin-dependent diabetes mellitus: comparison of the effect on blood sugar, body weight, and serum lipids. *Diabetes Care* 1983;6:50–6.
- [40] Wing RR, Epstein LH, Nowalk MP, Koeske R, Hagg S. Behavior change, weight loss, and physiological improvements in type ii diabetic patients. *J Consult Clin Psych* 1985;53:111–22.
- [41] Hartwell S, Kaplan R, Wallace J. Comparison of behavioral interventions for control of type ii diabetes mellitus. *Behav Ther* 1986;17:447–61.
- [42] White N, Carnahan J, Nugent CA, Iwaoka T, Dodson MA. Management of obese patients with diabetes mellitus: comparison of advice education with group management. *Diabetes Care* 1986;9:490–6.
- [43] Rodriguez F, Alvarez M. Modificación de conducta y mejora en el cumplimiento del tratamiento en diabeticos tipo ii. *Rev Esp Ter Comportamiento* 1987;5:223–47.
- [44] Wing RR, Marcus MD, Epstein LH, Jawad A. A “Family-based” approach to the treatment of obese type ii diabetic patients. *J Consult Clin Psych* 1991;59:156–62.
- [45] D'Eramo-Melkus GA, Wylie-Rosett J, Hagan JA. Metabolic impact of education in NIDDM. *Diabetes Care* 1992;15:864–9.
- [46] Boehm S, Schlenk EA, Raleigh E, Ronis D. Behavioral analysis and behavioral strategies to improve self-management of type ii diabetes. *Clin Nurs Res* 1993;2:327–44.
- [47] Smith DE, Heckemeyer CM, Kratt PP, Mason DA. Motivational interviewing to improve adherence to a behavioral weight-control program for older obese women with NIDDM: a pilot study. *Diabetes Care* 1997;20:52–4.
- [48] Aikens JE, Kiolbasa TA, Sobel R. Psychological predictors of glycemic change with relaxation training in non-insulin-dependent diabetes mellitus. *Psychother Psychosom* 1997;66:302–6.
- [49] Henry J, Wilson P, Bruce D, Chisholm D, Rawling P. Cognitive-behavioural stress management for patients with non-insulin dependent diabetes mellitus. *Psychol Health Med* 1997;2:109–18.
- [50] Jablon SL, Naliboff BD, Gilmore SL, Rosenthal MJ. Effects of relaxation training on glucose tolerance and diabetic control in type ii diabetes. *Appl Psychophys Biof* 1997;22:155–69.
- [51] Huang X, Song Y, Yao S. The effect of social support on type ii diabetes with depression. *Chin J Clin Psychol* 2001;9:187–9.
- [52] McKay HG, King D, Eakin EG, Seeley JR, Glasgow RE. The diabetes network internet-based physical activity intervention: a randomized pilot study. *Diabetes Care* 2001;24:1328–34.
- [53] Zhu X, Gong Y, Yao S. The effect of biofeedback assisted relaxation training on cytokines in patients with type ii diabetes. *Chin J Clin Psychol* 2001;9:170–2.
- [54] Surwit RS, van Tilburg MA, Zucker N, McCaskill CC, Parekh P, Feinglos MN, Edwards CL, Williams P, Lane JD. Stress management improves long-term glycemic control in type 2 diabetes. *Diabetes Care* 2002;25:30–4.
- [55] Tsujiuchi T, Kumano H, Yoshiuchi K, He D, Tsujiuchi Y, Kuboki T, Suematsu H, Hirao K. The effect of qi-gong relaxation exercise on the control of type 2 diabetes mellitus: a randomized controlled trial. *Diabetes Care* 2002;25:241–2.
- [56] Delamater AM. Improving patient adherence. *Cd (Clinical Diabetes)* 2006;24:71–2.
- [57] Mojica WA, Suttrop MJ, Sherman SE, Morton SC, Roth EA, Maglione MA, Rhodes SL, Shekelle PG. Smoking-cessation interventions by type of provider: a meta-analysis. *Am J Prev Med* 2004;26:391–401.
- [58] Knight KM, Dornan T, Bundy C. The diabetes educator: trying hard, but must concentrate more on behaviour. *Diabetic Med* 2006;23:485–501.
- [59] Snoek FJ. Rapid response: not the magic bullet. *Brit Med J* 2006;333(June):65. Available online: <http://www.bmj.com/cgi/eletters/333/7558/65> [last accessed 23/01/2008, 2006].
- [60] Hermanns N, Kulzer B, Krichbaum M, Kubiak T, Haak T. How to screen for depression and emotional problems in patients with diabetes: comparison of screening characteristics of depression questionnaires, measurement of diabetes-specific emotional problems and standard clinical assessment. *Diabetologia* 2006;49:469–77.