Psychological Interventions for the Management of Glycemic and Psychological Outcomes of Type 2 Diabetes Mellitus in China: A Systematic Review and Meta-Analyses of Randomized Controlled Trials

Anna Chapman1,2*, Shuo Liu3, Stephanie Merkouris1,4, Joanne C. Enticott1,5, Hui Yang1, Colette J. Browning1,2 and Shane A. Thomas1

1 School of Primary Health Care, Monash University, Notting Hill, VIC, Australia, 2 Royal District Nursing Service Institute, Melbourne, VIC, Australia, 3 Beijing Office for Cancer Prevention and Control, Peking University Cancer Hospital and Institute, Beijing, China, 4 School of Psychology, Deakin University, Melbourne, VIC, Australia, 5 School of Clinical Sciences, Monash University, Melbourne, VIC, Australia

Introduction: China has the largest number of type 2 diabetes mellitus (T2DM) cases globally, and T2DM management has become a critical public health issue in China. Individuals with T2DM have an increased risk of developing mental health disorders, psychological disturbances, and functional problems associated with living with their condition. Previous systematic reviews have demonstrated that, generally, psychological interventions are effective in the management of T2DM-related outcomes; however, these reviews have predominantly included studies conducted within English-speaking countries and have not determined the efficacy of the varying types of psychological interventions. As such, this paper aims to synthesize evidence and quantify the efficacy of psychological therapies for the management of glycemic and psychological outcomes of T2DM in China, relative to control conditions.

Methods: A systematic search (MEDLINE, PsycINFO, CINAHL, Cochrane Central Register of Controlled Trials, China National Knowledge Infrastructure, and Wangfang Data) for all years to December 2014 identified all available literature. Eligibility criteria included: peer-reviewed journal articles, randomized controlled trials (RCTs) assessing the efficacy of a psychological therapy for the management of T2DM, adult participants (≥18 years) diagnosed with T2DM or non-insulin-dependent diabetes mellitus, and Chinese speaking participants only (in mainland China). Outcome measures were glycated hemoglobin, blood glucose concentration, depression, anxiety, and quality of life. Effect sizes were pooled using a random effects model. Negative effect sizes corresponded to positive outcomes favoring the intervention.

Results: Forty-five RCTs were eligible for the meta-analyses. Cognitive behavioral therapy (CBT) and motivational interviewing (MI) were more effective than the control
Type 2 diabetes mellitus (T2DM) is a complex metabolic condition that requires effective long-term management in order for patients to achieve optimal glycemic control and to prevent chronic complications (1). As lifestyle, behavioral, and psychological changes are fundamental to the management of T2DM, it is essential for health care teams and patients to work collaboratively to ensure patients adhere to clinical recommendations and the T2DM self-care regimen (2). Internationally, evidence-based guidelines recognize the importance of a structured and systematic approach to the management of T2DM in the primary care setting that incorporates psychological care within clinical recommendations (3–5). It is also widely recognized that compared to the general population, individuals with T2DM have a higher prevalence of clinical and sub-clinical levels of depression and anxiety (6, 7), with the potential consequences being reductions in glycemic control, quality of life, and treatment adherence (7, 8).

Type 2 diabetes mellitus in China has reached epidemic proportions and has largely been attributed to the rapid urbanization China has experienced over the past two decades. This urbanization has triggered significant improvements in living conditions and socioeconomic status for Chinese residents and has resulted in reductions in physical activity and increases in high energy, high fat diets, body mass index, and central upper-body adiposity (9). With the largest global population of diabetes mellitus (DM), the International Diabetes Federation has advised that China will face significant challenges in its response to DM (10). Recent data suggests that 96.3 million adults in China have DM, and this figure is expected to rise to 142.7 million by 2035 if no action is taken (10).

Typically, chronic illness management approaches in China are not patient centered, nor do they include a central role for the patient in the self-management of their condition (11). Furthermore, patients are often dissatisfied with the medical services they receive while doctors focus on providing medications to manage chronic diseases rather than the facilitation of behavior change to moderate or control these conditions (12, 13). Doctors and nurses in China are not specifically trained in psychology, and their skills are often limited in the counseling and behavior change techniques that have been recognized as having the potential to assist patients in adhering to the lifestyle changes necessary for effective management of T2DM (14).

Previous systematic reviews and meta-analyses (15–17) have demonstrated that, generally, psychological interventions can be effective in the management of T2DM, through the examination of key outcomes including glycated hemoglobin and psychological status. However, these reviews were limited by assessing the effectiveness of psychological interventions as a whole, with no distinction between the varying therapeutic types. Furthermore, the effectiveness of psychological interventions in the previous reviews has largely been based on research conducted within English-speaking countries. To date, no reviews have focused on the effectiveness of psychological interventions of T2DM in China, and previous reviews have only utilized international databases [that have limited indexation of Chinese-language journals (18)] in their search strategies. Given that the majority of research conducted in China is published in Chinese-language journals (19), there is considerable risk that many pertinent studies may have been overlooked.

With such large and increasing numbers of people with T2DM in China, and the ensuing research that is being conducted in China to address this issue, it is necessary that a review of psychological interventions for the management of T2DM focusing on China be performed. By conducting a comprehensive assessment of relevant T2DM management interventions, future and effective interventions can be tailored to meet the needs of a growing T2DM population in China. As such, this paper presents the first systematic review and meta-analyses of psychological interventions for the management of glycemic and psychological outcomes of T2DM in China that uses both international and Chinese-language databases, in order to quantify the efficacy of interventions relative to control conditions.

**METHODS**

This review is reported according to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines (20).
Data Sources and Search Strategy
A systematic search identified all available studies assessing the efficacy of psychological interventions for the management of T2DM in China. Electronic databases were searched for both internationally published literature (MEDLINE, PsycINFO, CINAHL, and Cochrane Central Register of Controlled Trials) and Chinese-language literature (China National Knowledge Infrastructure and Wangfang data – the two most comprehensive Chinese academic databases). A combination of keywords, wildcards, and appropriate truncation for each database relating to DM (“Diabetes Mellitus” “糖尿病”), psychological interventions (“Psych$” “心理” or “Therap$” “治疗” or “Counsel$” “咨询” or “Self-manag$” “自我管理”), and China (“China” or “Chinese” “中国”) was used. The following Chinese journals were also searched manually: Chinese Mental Health Journal (1994 onward) and Shanghai Archives of Psychiatry (1994 onward). The reference lists of included studies and relevant reviews were searched manually. The search was restricted to peer-reviewed journal articles for all years up to December 2014. First, four authors (AC and SM for international databases and SL and HY for Chinese databases) independently assessed titles and abstracts of studies for inclusion. Second, both groups of authors compared selected studies for inclusion. When discrepancies occurred, consensus was reached through discussion with all four assessing authors (AC, SM, SL, and HY).

Inclusion Criteria
Eligibility criteria included randomized controlled trials (RCTs) of a psychological intervention, adult participants (≥18 years) with a diagnosis of T2DM or non-insulin-dependent DM, and Chinese-speaking participants only (in mainland China). Studies that did not specifically identify the type of DM or combined types of DM, not separated in analysis, were excluded from the review.

The most commonly used psychotherapeutic models for the management of T2DM were used to categorize psychological interventions. These were cognitive behavioral therapy (CBT), motivational interviewing (MI), client-centered therapy (CCT), brief psychodynamic psychotherapy (BPP), and interpersonal psychotherapy (IPT) (see Box 1 for definitions). Studies that clearly labeled the therapeutic model used in their intervention were accepted at face value. Where interventions were not clearly labeled, these studies were included and categorized if they used one or more psychological techniques that could be classified as a component of a specific psychotherapy (e.g., relaxation training classified as a component of CBT). This process was performed independently by two authors (AC and SM), and when discrepancies occurred, consensus was reached by consulting a third author (SL). Studies that did not clearly describe the psychological component of the intervention were excluded. Appropriate control groups were defined as non-psychological and included usual care, waitlist, and education. According to the Chinese Guideline for Diabetes Prevention and Management (21), usual care refers to quarterly doctor consultations and completion of an annual physical examination. Control groups that experienced a less intensive psychological therapy were excluded.

The primary outcome measure was glycated hemoglobin. Additional outcomes included fasting blood glucose concentration, depression, anxiety, and overall quality of life (QOL) as measured by validated tools. With regard to depression and anxiety, both diagnostic and symptom severity tools were considered appropriate for inclusion. Studies were excluded if they did not report any outcome measures within scope. For multiple reports of a primary study, we maximized the yield of information by collating all data. The publication reporting the longest follow-up was assigned priority.

Data Extraction
Data from included studies were extracted and translated into English using a standardized template by two authors (HY and SL) who are fluent in English and Mandarin. This included study and sample characteristics (i.e., clinical subgroups and sample size), design features (i.e., therapy type, delivery mode, duration, and regimen of treatment conditions), and study results (i.e., means and SD). Only data reported in the original papers were used for extraction, and no attempts were made to contact authors for additional information.

Risk of Bias
The Cochrane Collaboration’s tool for assessing risk of bias was utilized to examine the risk of bias in each included study (22).
RESULTS

Search Results

Once duplicates were removed, the search yielded 2,118 citations from which 236 full text articles were examined (Figure 1). Of these, 48 articles from 47 RCTs were included in the systematic review and 45 RCTs in the meta-analyses.

Characteristics of included studies are displayed in Table 1. All but one article (27) (a secondary reference) was published after 2000. Both men and women were included in the samples of all RCTs, and sample size ranged from 59 to 598 (119 ± 101). The mean age of participants was 52.8 ± 11.8 years. General T2DM patients were the most commonly specified clinical group (k = 35), followed by patients with comorbid depression and/or anxiety (k = 10). Mean duration of T2DM was 5.2 ± 3.8 years, and mean duration of follow-up (which typically coincided with intervention duration) was 3.2 months. Most RCTs used either CBT (k = 12) or its associated techniques (k = 25), with the most commonly used being relaxation training. Five RCTs utilized MI, and five utilized CCT. There were no RCTs that utilized BPP or IPT. No RCTs reported using manualized therapies. Usual care was the most frequently used control condition (k = 43). The majority of RCTs were conducted within a hospital setting (k = 43).

Meta-Analyses

A summary of the estimated effects of the meta-analyses and heterogeneity are included in Table 2.

Cognitive Behavioral Therapy

Twenty RCTs (n = 2,900) were included in the meta-analysis comparing CBT with a control group for glycated hemoglobin and results indicated that CBT was more beneficial than the control condition (SMD = −0.97, 95% CI: −1.37 to −0.57) (Figure 2). This corresponded to an effect size of −1.56% in absolute units. The χ² test for heterogeneity was significant, with considerable heterogeneity (χ² = 430.87, P < 0.0001, F = 96%). Various subgroup analyses were conducted to explore this heterogeneity. While there were slight variations in the effect sizes, no significant differences were found between the following subgroups: clinical subgroup (P = 0.32), modality of therapy (P = 0.50), timing of glycated hemoglobin outcome assessment (P = 0.16), and classification of treatment type (P = 0.68).

Twenty-seven RCTs (n = 3,084) were included in the meta-analysis comparing CBT with a control group for depression and results indicated that CBT was more beneficial than the control condition (SMD = −1.22, 95% CI: −1.51 to −0.94) (Figure S1 in Supplementary Material). The χ² test for heterogeneity was significant, with considerable heterogeneity (χ² = 331.61, P < 0.0001, F = 92%). Various subgroup analyses were conducted to explore this heterogeneity. While there were slight variations in the effect sizes, no significant differences were found between the following subgroups: clinical subgroup (P = 0.99), modality of therapy (P = 0.23), and classification of treatment type (P = 0.39).
Twenty-one RCTs (n = 2,479) were included in the meta-analysis comparing CBT with a control group for anxiety and results indicated that CBT was more beneficial than the control condition (SMD = −1.03, 95% CI: −1.26 to −0.80) (Figure S2 in Supplementary Material). The χ² test for heterogeneity was significant, with substantial to considerable heterogeneity (χ² = 130.53, P < 0.0001, I² = 85%). Various subgroup analyses were conducted to explore this heterogeneity. While there were slight variations in the effect sizes, no significant differences were found between the following subgroups: clinical subgroup (P = 0.37), modality of therapy (P = 0.44), and classification of treatment type (P = 0.41).

Twenty-eight studies (n = 3,802) were included in the meta-analysis comparing CBT with a control group for blood glucose concentration and results indicated that CBT was more beneficial than the control condition (SMD = −0.98, 95% CI: −1.25 to −0.72) (Figure S3 in Supplementary Material). The χ² test for heterogeneity was significant, with considerable heterogeneity (χ² = 373.18, P < 0.0001, I² = 93%). Various subgroup analyses were conducted to explore this heterogeneity. While there were slight variations in the effect sizes, no significant differences were found between the following subgroups: clinical subgroup (P = 0.48), modality of therapy (P = 0.35), and classification of treatment type (P = 0.81).

Five studies (n = 722) were included in the meta-analysis comparing CBT with a control group for overall QOL and results indicated that the difference between CBT and the control condition was not significant (SMD = −0.65, 95% CI: −1.35 to 0.06) (Figure S4 in Supplementary Material). The χ² test for heterogeneity was significant, with considerable heterogeneity (χ² = 71.84, P < 0.0001, I² = 94%). There were insufficient studies to conduct subgroup analyses to explore this heterogeneity.

Funnel plots and Egger’s tests were conducted for all CBT outcomes with the exception of QOL, for which there were insufficient studies (k = 5). No evidence of publication bias was found for two of the outcomes, glycated hemoglobin (P = 0.608), and blood glucose concentration (P = 0.873). However, publication bias was indicated for the CBT outcomes of depression (P = 0.001) and anxiety (P = 0.007) (Funnel plots and Egger’s test not shown – see Supplementary Material).

**Motivational Interviewing**

Three studies (n = 251 participants) were included in the meta-analysis comparing MI with a control group for glycated hemoglobin and results indicated that MI was more beneficial than the control condition (SMD = −0.71, 95% CI: −1.00 to −0.43) (Figure 3). This corresponded to an effect size of −0.92% in absolute units. The χ² test for heterogeneity was not significant, with heterogeneity considered not important (χ² = 2.43, P = 0.30, I² = 18%).

There were insufficient studies to conduct a meta-analysis comparing MI with a control for the additional outcomes. Qualitatively, two studies assessed blood glucose concentration, and both found significant improvements (P > 0.05) favoring MI compared with the control (28, 29). Additionally, two studies assessed QOL, and both found significant improvements (P > 0.05) favoring MI compared with the control (28, 30). No studies utilizing MI assessed depression or anxiety.

**Client-Centered Therapy**

Four studies (n = 451 participants) were included in the meta-analysis comparing CCT with a control group for glycated hemoglobin, and results indicated that the difference between CCT and the control condition was not significant (SMD = −0.96,
| Reference | Number of participants recruited/at follow-up | Mean age ± SD (or range) | Clinical subgroup | Mean duration of diabetes ± SD (or range) | Setting | Model and duration of therapy in intervention group | Regimen in intervention group and specialty of therapist | Model and duration of therapy in control group | Regimen in control group and specialty of therapist | Follow-up (months from baseline) | Outcome measures of relevance |
|-----------|---------------------------------------------|--------------------------|-------------------|------------------------------------------|---------|-------------------------------------------------|------------------------------------------------|------------------------------------------------|------------------------------------------------|---------------------------------|-------------------------------|
| (47)      | 60/60                                       | 72.9 ± 9.6               | Depression        | 8.6 ± 3.0                                | Hospital (I) | Individual CBT for 2 months                    | CBT sessions consisting of relaxation training, music relaxation therapy, emotional adjustment, and psychological support by nurse (number of sessions and manualization NS) | UC for 2 months                      |                                    | 2                               | FBG and HAM-D                  |
| (50)      | 72/72                                       | 66.0 ± 17.4              | General           | 6.8 ± 14.9                               | Hospital (I) | Individual CBT for 2 months                    | CBT sessions consisting of rational emotive therapy and relaxation training (therapist and manualization NS) | UC for 2 months                      |                                    | 2                               | SAS, SDS                       |

(Continued)
TABLE 1 | Continued

| Reference | Number of participants recruited/at follow-up | Mean age ± SD (or range) (years) | Clinical subgroup | Mean duration of diabetes ± SD (or range) (years) | Setting | Model and duration of therapy in intervention group | Regimen in intervention group and specialty of therapist | Model and duration of therapy in control group | Regimen in control group and specialty of therapist | Follow-up (months from baseline) | Outcome measures of relevance |
|-----------|---------------------------------------------|---------------------------------|-------------------|-----------------------------------------------|---------|------------------------------------------------|---------------------------------------------------|---------------------------------|---------------------------------|-----------------------------|--------------------------------|
| (28)      | 60/60                                       | 41.5 ± 8.1                      | General           | 2.3 ± 0.2                                     | NS      | Individual MI and exercise therapy for 6 months | 6 MI sessions and 72 sessions of moderate intensity exercise training all by nurse (manualization NS) | Exercise therapy and education for 6 months | Exercise therapy and education for 6 months | 6                           | HbA1c, FBG, and DQoL |
| (51)      | 60/60                                       | 53.0 ± 10.6                     | Depression and anxiety | 6.4 ± 3.1                                     | Hospital (I and O) | Individual CBT and group education for 1 month | 8 CBT sessions consisting of behavior modification, planning, stress management, and psychological support (therapist NS), group education (number of sessions, therapist, and manualization NS) | UC for 1 month | UC for 1 month | 1                           | HbA1c, FBG, SAS, and SDS |
| (52)      | 132/132                                     | 49.6 ± 12.0                     | General           | 6.1 ± 3.1                                     | Hospital (I) | Individual CBT for 1 month | 8 CBT sessions consisting of behavior modification, relaxation training, music relaxation therapy, psychological support, and family therapy by psychologist (manualization NS) | UC for 1 month | UC for 1 month | 1                           | HbA1c, FBG, SAS, and SDS |
| (53)      | 62/62                                       | 58.6 ± 7.5                      | Depression        | 6.1 ± 2.6                                     | Community health | Individual and group CBT for 3 months | 14 CBT sessions by doctor and endocrinologist (manualization NS) | UC for 3 months | UC (regimen and therapist NS) | 5                           | HbA1c, FBG, and SDS |
| Reference | Number of participants recruited/at follow-up | Mean age ± SD (or range) (years) | Clinical subgroup | Mean duration of diabetes ± SD (or range) (years) | Setting | Model and duration of therapy in intervention group | Regimen in intervention group and specialty of therapist | Model and duration of therapy in control group | Regimen in control group and specialty of therapist | Follow-up (months from baseline) | Outcome measures of relevance |
|-----------|---------------------------------------------|---------------------------------|-------------------|-----------------------------------------------|---------|-------------------------------------------------|------------------------------------------------|--------------------------------------------|---------------------------------------------|---------------------------------------------|-----------------------------------------------|
| (54)      | 598/598                                     | 56.4 ± 11.6                     | General           | 4.8 ± 3.9                                     | Hospital (O) | Individual CBT and individual and group education for 7 months | CBT consisting of behavior modification and planning (number of sessions, therapist, and manualization NS), and individual and group education sessions (number of sessions and therapist NS) | UC for 7 months | UC and usual medication (regimen and therapist NS) | 7                                           | HbA1c and FBG                               |
| (55)      | 120/105                                     | 57.0 ± 8.5                      | General           | 5.3 ± 2.2                                     | Hospital (I and O) | Individual CCT and health education for 6 months | 12 non-directive counseling sessions with an emphasis on positive thinking by therapist, education sessions by doctor and therapist (number of sessions and manualization NS) | UC for 6 months | UC (regimen and therapist NS) | 6                                           | HbA1c and FBG                               |
| (56)      | 87/87                                       | 51.6 ± 8.0                      | General           | 5.3 ± 4.4                                     | Hospital (I) | Individual CBT, family therapy, and group education for 3 months | 12–24 CBT sessions consisting of behavior modification, exercise therapy, psychological support, and family therapy, 12 education sessions; all by psychiatric attending physician (manualization NS) | UC for 3 months | UC and usual medication (regimen and therapist NS) | 3                                           | HbA1c, FBG, SAS, and SDS                  |
| (57)      | 108/108                                     | 50.9 ± 11.1                     | Depression        | 4.6 ± 3.4                                     | Hospital (I and O) | Individual CBT for 6 weeks | CBT sessions consisting of relaxation training, music relaxation therapy, planning, and psychological support (number of sessions, therapist and manualization NS) | UC for 6 weeks | UC (regimen and therapist NS) | 1.5                                         | HbA1c, FBG, HAM-D                           |
| (58)      | 86/86                                       | 53.0 ± 8.2                      | General           | 6.3 ± 2.2                                     | Hospital (I) | Individual CBT for 1 month | 8 CBT sessions consisting of stress management, behavior modification, planning, and psychological support by psychologist (manualization NS) | UC for 1 month | Usual nutrition, exercise, and medication (regimen and therapist NS) | 1                                           | SDS                                         |
| Reference | Number of participants recruited/at follow-up | Mean age ± SD (or range) (years) | Clinical subgroup | Setting | Model and duration of therapy in intervention group | Regimen in intervention group and specialty of therapist | Model and duration of therapy in control group | Regimen in control group and specialty of therapist | Follow-up (months from baseline) | Outcome measures of relevance |
|-----------|---------------------------------------------|----------------------------------|-------------------|---------|---------------------------------------------------|-------------------------------------------------|--------------------------------|--------------------------------|-----------------------------|--------------------------------|
| (50)     | 94/94                                       | 53.1 ± 7.4                       | Nephropathy       | NS      | Individual and group CBT for 6 months             | 24 CBT sessions by psychologist (manualization NS) | UC for 6 months                | UC consisting of education, glucose monitoring, nutrition, exercise, and monitoring of blood glucose, blood pressure, and lipids (regimen and therapist NS) | 6                           | HbA1c, FBG, SAS, and SDS   |
| (56)     | 438/438                                     | 51.6 ± NS                        | General           | NS      | Individual CBT for 1 month                        | CBT sessions by DM health professional (number of sessions and manualization NS) | UC for 1 month                 | Usual medication (regimen and therapist NS) | 1                           | HbA1c, FBG, SAS, and SDS   |
| (51)     | 82/80                                       | 56.8 ± 13.2                      | General           | 5.5 ± 4.7 | Hospital (I and O) Individual CBT for 1 month     | 8 CBT sessions consisting of relaxation training and psychological support (therapist and manualization NS) | UC for 1 month                 | UC (regimen and therapist NS) | 1                           | HbA1c, FBG, and SCL-90     |
| (52)     | 60/60                                       | 51.2 ± 11.7                      | General           | 3.3 ± 3.7 | Hospital (I) Individual CBT for 1 month          | 10 CBT sessions consisting of rational emotive therapy by diabetes specialist nurse (manualization NS) | UC and education for 1 month | UC and education (regimen and therapist NS) | 1                           | SCL-90                       |
| (53)     | 118/118                                     | NS (40–80)                       | Depression        | 6.0 ± 7.0 | Hospital (I) Individual CBT for 1 month          | 3–4 CBT sessions consisting of cognitive restructuring, relaxation training, and psychological support (therapist and manualization NS) | UC for 1 month                 | UC (regimen and therapist NS) | 1                           | HbA1c, FBG, SAS, and SDS   |
| (54)     | 72/72                                       | 53.1 ± 11.0                      | General           | NS      | Individual and group CBT and family therapy for 6 months | CBT sessions and family therapy by psychiatrist (number of sessions, therapist, and manualization NS) | UC for 6 months | Usually medication (regimen and therapist NS) | 6                           | SCL-90 and DSQoL             |

(Continued)
| Reference | Number of participants recruited at follow-up | Mean age ± SD (or range) (years) | Clinical subgroup | Mean duration of diabetes ± SD (or range) (years) | Setting | Model and duration of therapy in intervention group | Model and duration of therapy in control group | Regimen in control group and specialty of therapist | Regimen in intervention group and specialty of therapist | Follow-up (months from baseline) | Outcome measures of relevance |
|-----------|-----------------------------------------------|----------------------------------|-------------------|-----------------------------------------------|---------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-------------------------------|-----------------------------|
| (65)      | 63/63                                        | 63.1 (60–79)                     | Elderly (60+)     | NS                                            | Hospital (Military Psychiatric Hospital) (I) | Individual CBT and group education for 2 weeks | 10 sessions of Qigong relaxation training, 10 sessions of music relaxation therapy, and 4 group education sessions all by doctor (manualization NS) | UC for 2 weeks | UC (regimen and therapist NS) | 0.5                           | HAM-A and SCL-90              |
| (66)      | 96/96                                        | 56.8 ± 3.9                      | General           | 7.5 (3–12)                                    | Hospital (I) | Individual CBT and individual and group education for 3 months | Non-directive counseling sessions with an emphasis on improvement of self-esteem and positive thinking by psychologist (number of sessions and manualization NS), education sessions by DM specialist and nurse (number of sessions NS) | UC for 3 months | UC (regimen and therapist NS) | 3                             | HbA1c, FBG, and SDS          |
| (67)      | 67/67                                        | 44.5 ± 11.0                     | Depression and anxiety | 4.6 ± 3.4                                      | Hospital (I and O) | Individual and group CBT for 6 weeks | 6 CBT sessions consisting of relaxation training, behavior modification, and psychological support by psychiatric attending physician (manualization NS) | UC for 6 weeks | Usual medication (regimen and therapist NS) | 1.5                           | HbA1c, FBG, SAS, and SDS     |
| (35)      | 70/70                                        | 60.5 ± 10.2                     | Depression        | NS                                            | Hospital (I) | Individual and group CBT for 2 months | 8 CBT sessions (individual and group) consisting of relaxation training, emotional adjustment, and psychological support (therapist and manualization NS) | UC and education for 2 months | Usual nutrition, exercise and medication (regimen and therapist NS), 8 education sessions, and DM hotline by DM specialist nurse (regimen NS) | 2                             | HbA1c, FBG, HAM-D, and DSQoL |

(Continued)
| Reference | Number of participants recruited/at follow-up | Mean age ± SD (or range) | Clinical subgroup | Mean duration of diabetes ± SD (or range) | Setting | Model and duration of therapy in intervention group | Regimen in intervention group and specialty of therapist | Model and duration of therapy in control group | Regimen in control group and specialty of therapist | Follow-up (months from baseline) | Outcome measures of relevance |
|-----------|----------------------------------------------|--------------------------|-------------------|-------------------------------------------|---------|--------------------------------------------------|--------------------------------------------------|------------------------------------------|--------------------------------------------------|---------------------------------------------|-------------------------------------------|
| (58)      | 93/93                                        | 53.6 ± 8.3               | General           | 5.7 ± 3.7                                 | Hospital (I) | Individual CBT and group education for 1 month | CBT consisting of emotional adjustment, relaxation training, exercise therapy (number of sessions and manualization NS), and 8 group education sessions; all by multidisciplinary team (endocrinologist, nurse, and dietitian) | UC for 1 month | Usual nutrition, exercise, and medication (regimen and therapist NS) | 1                                           | FBG, SAS, and SDS |
| (59)      | 300/300                                      | NS (41–79)               | General           | 6.0 ± NS                                   | Hospital (I) | Individual CBT for 6 months | 48 CBT sessions consisting of relaxation training, exercise therapy, emotional adjustment, behavior modification, and psychological support (therapist and manualization NS) | UC for 6 months | Usual medication by doctor (regimen NS) | 6                                           | HbA1c, FBG, and SCL-90 |
| (70)      | 80/80                                        | 40.8 (22–60)             | General           | NS                                        | Hospital (I) | Individual and group CBT for 3 months | 12 CBT sessions consisting of morita therapy (individual and group), relaxation training, music relaxation therapy and psychological support by doctor and nurse (manualization NS), and education sessions by doctor and nurse (number of sessions NS) | UC for 3 months | UC consisting of clinical treatment and nursing care (regimen and therapist NS) | 3                                           | HbA1c, FBG, SAS, SDS, and DQoL |
| (71)      | 59/59                                        | 54.9 ± 8.4               | General           | NS (0.5–12)                               | Hospital (I) | Individual CBT and group education for 1 month | 30 CBT sessions consisting of music relaxation therapy (therapist and manualization NS) and 2 group education sessions (therapist NS) | UC for 1 month | UC (regimen and therapist NS) | 1                                           | HbA1c, FBG, SAS, and SDS |

(Continued)
| Reference | Number of participants recruited/at follow-up | Mean age ± SD (or range) (years) | Clinical subgroup | Setting | Model and duration of therapy in intervention group | Regimen in control group and specialty of therapist | Model and duration of therapy in control group | Regimen in control group and specialty of therapist | Follow-up (months from baseline) | Outcome measures of relevance |
|-----------|---------------------------------------------|---------------------------------|------------------|---------|--------------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|---------------------------------|-------------------------------|
| (72)      | 300/300                                     | 52.6 ± 17.6                     | General          | Hospital (O) | Individual CBT and group education for 6 months | UC for 6 months                               | Usual medication (regimen and therapist NS) |                                  | 6                               | HbA1c, FBG, SCL-90, and A-DQoL |
| (73)      | 80/80                                       | 54.8 ± 16.2                     | Low income       | Hospital (O) | Individual CBT for 3 months                      | UC for 3 months                               | Usual nutrition, exercise, medication, and glucose monitoring (regimen and therapist NS) |                                  | 3                               | HbA1c, FBG, and SDS            |
| (74)      | 100/100                                     | NS (20-70)                      | General          | Hospital (I) | Individual CBT for 1 month                       | UC for 1 month                                | UC (regimen and therapist NS)               |                                  | 1                               | FBG, HAM-A, and HAM-D          |
| (75)      | 68/68                                       | 58.0 ± 6.5                      | Depression       | Hospital (I) | Individual CBT for 1 month                       | UC for 1 month                                | UC consisting of clinical treatment, psychological counseling, and education by nurse (regimen NS) |                                  | 1                               | HbA1c, FBG, and SDS            |
| (31)      | 86/86                                       | 50.2 ± 7.6                      | General          | Hospital (NS) | Individual CCT and individual education for 3 months | UC for 3 months                               | Usual medication (regimen and therapist NS) |                                  | 3                               | FBG, SAS, and SDS              |

(Continued)
TABLE 1 | Continued

| Reference | Number of participants recruited or followed-up | Mean age ± SD (or range) | Clinical subgroup | Mean duration of diabetes ± SD (or range) | Setting | Model and duration of therapy in intervention group | Model and duration of therapy in control group | Setting | Regimen in intervention group and specialty of therapist | Regimen in control group and specialty of therapist | Follow-up (months from baseline) | Outcome measures of relevance |
|-----------|-----------------------------------------------|--------------------------|-------------------|-------------------------------------------|---------|-------------------------------------------------|---------------------------------|---------|-------------------------------------------------|---------------------------------|-----------------------------|----------------------------------|
| (76)      | 80/71                                         | 60.4 ± 9.9               | General           | 5.7 ± 3.1                                  | Community health | Individual MI for 6 months | MI sessions by nurse (number of sessions and manualization NS) | Community health | UC and family education/glucose monitoring for 6 months | Usual nursing care and one family session every 1–3 months consisting of glucose monitoring and education by nurse | 6 | HbA1c |
| (77)      | 95/95                                         | 56.8 ± 12.5              | General           | NS                                        | Hospital (I) | Group CBT and individual education for 2 weeks | 5 group CBT consisting of relaxation training (therapist NS), and individual psychological support and education (number of sessions, therapist, and manualization NS) | Hospital (I) | UC for 2 weeks | UC (regimen and therapist NS) | 0.5 | FBG and DSOoL |
| (78)      | 200/200                                       | 52.4 ± 11.2              | Depression        | 6.3 ± 4.2                                  | Hospital (II and O) | Individual CBT for 1 month | 8 CBT sessions consisting of behavior modification, relaxation training, psychological support, and exercise therapy (therapist and manualization NS) | Hospital (II and O) | UC for 1 month | Usual medication (regimen and therapist NS) | 1 | FBG and SDS |
| (79)      | 184/175                                       | 48.0 ± 8.0               | General           | 4.0 ± 1.0                                  | Hospital (II) | Individual and group CBT (duration NS) | 20 CBT sessions – individual and group (therapist and manualization NS) | Hospital (II) | UC and education (duration NS) | UC and education (regimen and therapist NS) | NS | FBG and GQoL-74 |
| (80)      | 120/113                                       | 52.0 ± 12.0              | General           | NS (2–13)                                  | Hospital (I) | Individual CBT (duration NS) | 8 CBT sessions consisting of morita therapy and relaxation training by psychologist (number of sessions and manualization NS) | Hospital (I) | UC for 2 months | Usual nutrition and medication (regimen and therapist NS) | 2 | FBG, SAS, and SDS |

(Continued)
| Reference | Number of participants recruited/at follow-up | Mean age ± SD (or range) (years) | Clinical subgroup | Mean duration of diabetes ± SD (or range) (years) | Setting | Model and duration of therapy in intervention group | Regimen in intervention group and specialty of therapist | Model and duration of therapy in control group | Regimen in control group and specialty of therapist | Follow-up (months from baseline) | Outcome measures of relevance |
|-----------|---------------------------------------------|---------------------------------|-------------------|-----------------------------------------------|---------|------------------------------------------------|------------------------------------------------|------------------------------------------------|------------------------------------------------|-----------------------------|----------------------------|
| (32)      | 100/100                                     | 44.2 ± 6.8                      | General           | 4.6 ± 2.5                                    | Hospital (I) | Individual CCT and family therapy for 1 month | Non-directive counseling sessions with an emphasis on improvement of self-esteem and positive thinking (number of sessions, therapist, and manualization NS) and family therapy (number of sessions and therapist NS) | UC for 1 month | Usual nutrition and medication (regimen and therapist NS) | 1                           | HbA1c, FBG, SAS, and SDS            |
| (81)      | 150/150                                     | 32.4 ± 12.0                     | General           | 5.3 ± 2.0                                    | Hospital (I) | Individual CCT, individual education and family therapy for 3–4 weeks | Non-directive counseling sessions with an emphasis on improvement of self-esteem and positive thinking (number of sessions and manualization NS) and family therapy (number of sessions NS); all by doctor and nurse | UC for 3–4 weeks | Usual nutrition, exercise, and medication (regimen and therapist NS) | 0.75–1                      | HbA1c and FBG                   |
| (29)      | 120/120                                     | NS (36–88)                      | General           | NS                                           | Hospital (I) | Individual MI for 3 sessions (duration NS) | 3 MI sessions (therapist and manualization NS) | Usual education (duration NS) | Usual education consisting of group seminars and individual education focusing on nutrition, medication, exercise, and blood glucose monitoring (regimen and therapist NS) | NS                          | HbA1c and FBG                   |
| Reference | Number of participants recruited/at follow-up | Mean age ± SD (or range) (years) | Clinical subgroup | Mean duration of diabetes ± SD (or range) (years) | Setting | Model and duration of therapy in intervention group | Regimen in intervention group and specialty of therapist | Model and duration of therapy in control group | Regimen in control group and specialty of therapist | Follow-up (months from baseline) | Outcome measures of relevance |
|-----------|---------------------------------------------|---------------------------------|-------------------|-----------------------------------------------|---------|-----------------------------------------------|-------------------------------------------------|-----------------------------------------------|-----------------------------------------------|-------------------------------|-----------------------------|
| (82)      | 60/60                                       | 63 (50–75)                      | General           | NS                                           | Hospital (I) | Individual and group CBT for 1 month          | 8 CBT sessions consisting of relaxation training, music relaxation therapy, and emotional adjustment by doctor and nurse trained in psychology (manualization NS) | UC for 1 month                   | Usual nutrition, exercise, and medication by doctor and nurse (regimen NS) | 1                             | FBG                          |
| (83)      | 120/106                                     | 55.9 (30–60)                    | General           | 5.5 (2–11)                                   | Hospital (I and O) | Individual CBT and individual education for 6 months | Biofeedback assisted relaxation training (number of sessions NS), education (number of sessions NS), and 24 CBT sessions consisting of emotional adjustment and psychological support; all by psychologist (manualization NS) | UC for 6 months                  | Usual nutrition and medication (regimen and therapist NS) | 6                             | HbA1c, FBG, and GQOLI-74    |
| (84)      | 60/60                                       | 54.1 ± 11.9                     | General           | NS (0.5–16)                                  | NS       | Individual CBT and medication for 1 month    | 8 CBT sessions consisting of cognitive restructuring, emotional adjustment, relaxation training, music relaxation therapy, and psychological support (medication regimen, therapist, and manualization NS) | Medication for 1 month            | Medication (regimen and therapist NS) | 1                             | FBG, SAS, and SDS           |
### TABLE 1 | Continued

| Reference | Number of participants recruited/at follow-up | Mean age ± SD (or range) (years) | Clinical subgroup | Mean duration of diabetes ± SD (or range) (years) | Setting | Model and duration of therapy in intervention group | Regimen in intervention group and specialty of therapist | Model and duration of therapy in control group | Regimen in control group and specialty of therapist | Follow-up (months from baseline) | Outcome measures of relevance |
|-----------|---------------------------------------------|---------------------------------|-------------------|-----------------------------------------------|---------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|-----------------------------|-----------------------------|
| (85)<sup>a</sup> | 80/75 | 66.9 ± 5.5 | General | 9.6 ± 4.7 | Hospital (I) | Individual MI for 6 months | 22 MI sessions by nurse (manualization NS) | Education for 6 months | 6 group education sessions consisting of basic DM knowledge, nutrition, medication, exercise, glucose monitoring, and management of negative emotions (therapist NS) | 6 | HbA1c |
| (96) | 128/87 | Intervention: 53.96 ± 9.63 and control: 56.88 ± 8.87 | General | Intervention: 4.8 ± 5.2 and control: 4.3 ± 4.2 | Hospital (I) | Individual CBT<sup>a</sup> for 1 month | 8 sessions of biofeedback assisted relaxation training and music relaxation therapy (therapist and manualization NS) | UC for 1 month | UC (regimen and therapist NS) | 8 months (1998 cohort) to 2 years (1996 cohort) | HbA1c and FBG |
| (27)<sup>c</sup> | 67/56 | 54.0 ± 10.0 | General | NS (0.5–16) | Hospital (I) | Individual CBT<sup>a</sup> for 1 month | 8 sessions of biofeedback assisted relaxation training and music relaxation therapy (therapist and manualization NS) | UC for 1 month | UC (regimen and therapist NS) | 1 | HbA1c and FBG |
| (67) | 59/59 | 57.1 ± 9.6 | General | 4.8 ± 5.5 | Hospital (I) | Individual CBT<sup>a</sup> for 1 month | 8–12 sessions of biofeedback assisted relaxation training and music relaxation therapy (therapist and manualization NS) | UC for 1 month | UC (regimen and therapist NS) | 1 | STAI |

<sup>a</sup>Categorized into a specific therapy by the psychological techniques utilized in intervention.

<sup>b</sup>Study not included in meta-analyses.

<sup>c</sup>Secondary article.

NS, not specified; I, inpatient; O, outpatient; CCT, client-centered therapy; CBT, cognitive behavioral therapy; MI, motivational interviewing; UC, usual care.

Outcome measure abbreviations: Blood glucose concentration – FBG, fasting blood glucose; depression – SDS, Zung self-rating depression scale; HAM-D, Hamilton depression rating scale; SCL-90 (DEP), symptom checklist-90 depression scale; anxiety – SAS, Zung self-rating anxiety scale; HAM-A, Hamilton anxiety rating scale; SCL-90 (ANX), symptom checklist-90 anxiety scale; STAI, state-trait anxiety inventory; quality of life – WHOQoL-BREF, WHO quality of life-BREF; DQoL, disease-specific quality of life; A-DQoL, adjusted diabetes-specific quality of life; QOL-I, quality of life inventory; GQoLI-74, generic quality of life inventory-74.
| Outcomes                              | K  | N  | SMD | 95% CI             | Z (P)     | Heterogeneity |
|--------------------------------------|----|----|-----|-------------------|-----------|---------------|
| **CBT vs. control**                  |    |    |     |                   |           |               |
| Glycated hemoglobin                  | 20 | 2,900 | −0.97 | −1.37 to −0.57 | 4.72 (<0.0001) | 430.87 <0.0001 96 |
| Depression                           | 27 | 3,084 | −1.22 | −1.51 to −0.94 | 8.39 (<0.0001) | 331.61 <0.0001 92 |
| Anxiety                              | 21 | 2,479 | −1.03 | −1.26 to −0.80 | 8.91 (<0.0001) | 130.53 <0.0001 85 |
| Blood glucose concentration          | 28 | 3,802 | −0.98 | −1.25 to −0.72 | 7.20 (<0.0001) | 373.18 <0.0001 93 |
| Quality of life                      | 5  | 722  | −0.65 | −1.35 to 0.06  | 1.80 (P = 0.07) | 71.84 <0.0001 94 |
| **MI vs. control**                   |    |    |     |                   |           |               |
| Glycated hemoglobin                  | 3  | 251  | −0.71 | −1.00 to −0.43  | 4.88 (<0.0001) | 2.43 0.30 18  |
| **CCT vs. control**                  |    |    |     |                   |           |               |
| Glycated hemoglobin                  | 4  | 451  | −0.96 | −1.97 to 0.05   | 1.86 (P = 0.06) | 74.07 <0.0001 96 |
| Depression                           | 3  | 282  | −0.86 | −1.11 to −0.62  | 6.90 (<0.0001) | 1.16 0.56 0   |
| Blood glucose concentration          | 5  | 537  | −1.31 | −2.42 to −0.20  | 2.31 (P = 0.02) | 130.69 <0.0001 97 |

CBT, cognitive behavioral therapy; MI, motivational interviewing; CCT, client-centered therapy; K, number of studies; N, number of participants; SMD, standardized mean difference; CI, confidence interval.

The χ² test for heterogeneity was significant, with considerable heterogeneity (χ² = 74.07, P < 0.0001, I² = 96%).

Three studies (n = 282 participants) were included in the meta-analysis comparing CCT with a control group for depression and results indicated that CCT was more beneficial than the control condition (SMD = −0.96, 95% CI: −1.97 to 0.05) (Figure S5 in Supplementary Material). The χ² test for heterogeneity was not significant, with heterogeneity considered not important (χ² = 1.86, P = 0.06, I² = 0%).

Five studies (n = 537 participants) were included in the meta-analysis comparing CCT with a control group for blood glucose concentration. Results indicated that CCT was more beneficial than the control condition (SMD = −1.31, 95% CI: −2.42 to −0.20) (Figure S7 in Supplementary Material). The χ² test for heterogeneity was significant, with considerable heterogeneity (χ² = 130.69, P < 0.0001, I² = 97%).

There were insufficient studies to conduct subgroup analyses for any of the CCT comparisons and insufficient studies to conduct a meta-analysis comparing CCT with a control for the
Chapman et al.  
Psychological Interventions for Type 2 Diabetes in China

| Study or Subgroup | MI Mean | SD | Total Number | Control Mean | SD | Total Number | Weight | Std. Mean Difference IV, Random, 95% CI |
|-------------------|--------|----|--------------|-------------|----|--------------|--------|----------------------------------------|
| Dong 2013         | 6.43   | 1.32| 30           | 7.40        | 1.46| 30           | 25.6%  | -0.70 [-1.22, -0.18]                   |
| Wang 2011         | 6.79   | 0.8 | 35           | 7.55        | 0.67| 36           | 28.1%  | -1.02 [-1.52, -0.52]                  |
| Ye 2012           | 6.49   | 1.47| 60           | 7.28        | 1.49| 60           | 46.1%  | -0.53 [-0.89, -0.17]                  |
| Total (95% CI)    | 125    |    |              | 126         |    |              | 100.0% | -0.71 [-1.00, -0.43]                 |

**FIGURE 3** Meta-analysis illustrating the standardized effects of motivational interviewing (MI) vs. control for glycated hemoglobin.

### Risk of Bias Assessment

Table 3 summarizes the risk of bias assessment of the included studies. Eight RCTs clearly described an adequate random sequence generation (e.g., random number table) and were classified as low risk of bias. Four RCTs were classified as high risk of bias, as the sequence generation procedure used included a non-random component (e.g., allocation based on admission date). Thirty-five RCTs did not provide enough information on the randomization procedure and were classified as unclear.

All RCTs were classified as having an unclear risk of bias for allocation concealment and blinding of outcome assessors due to insufficient information.

Twenty-seven RCTs used an intention-to-treat approach and were classified as low risk of bias for incomplete outcome data. Twenty RCTs did not provide information on how missing data was handled and were classified as unclear.

Forty RCTs were classified as unclear for selective outcome reporting due to no protocols being available to determine if all outcome data collected was reported. Furthermore, it was difficult to ascertain through the published reports that all of the expected outcomes were reported (24). Seven RCTs were classified as having a high risk of bias as they did not report on all prespecified outcomes or time points, or the information provided did not allow inclusion in the meta-analysis.

### DISCUSSION

This systematic review is the first to assess the effectiveness of psychological interventions in improving T2DM-related outcomes in China. By systematically searching Chinese-language databases in addition to international (English language) databases, 40 additional RCTs were identified from that of previous reviews (15, 16). Furthermore, this review is the first to differentiate between the types of psychological interventions commonly utilized in the management of patients with T2DM. This enabled a more comprehensive and rigorous review and added strength to the meta-analyses conducted.

With regard to the primary outcome measure, glycated hemoglobin, results indicate that CBT and MI were more effective than the control condition, endorsing the use of the aforementioned psychological therapies for the improvement of glycemic control among patients with T2DM. The observed effect sizes in glycated hemoglobin were −0.97 (CBT) and −0.71 (MI), which resulted in absolute reductions in HbA1c of −1.56% (CBT) and −0.92% (MI). Based on the UK Prospective Diabetes Study (33), these effect sizes are enough to reduce the risk of development and progression of T2DM microvascular complications (15). Furthermore, these effect sizes and absolute differences are consistent, and higher, than previous meta-analyses of predominantly English-language literature which also found psychological interventions to be effective in improving glycemic control [effect sizes ranging from −0.29 (17) to −0.32 (15, 16); and absolute differences in HbA1c ranging from −0.54% (16) to −0.76% (15)].

Separate meta-analyses found both CBT and CCT to be associated with reductions in depression, and CBT with reductions in anxiety. Previous meta-analyses have similarly associated psychological interventions with improvements in psychological status (15, 16) and mental health (17); however, these studies combined depression, anxiety, wellbeing, and QOL into one outcome. Consequently, the differential effect of psychological interventions on each outcome has not previously been noted and is a feature unique to this review.

Improvement in blood glucose concentration was also observed in the meta-analysis for CBT. Only one previous meta-analysis has included blood glucose concentration as an outcome measure and in contrast found the effect size to be not significant (15).

In contrast to all other CBT meta-analyses, the observed effect of CBT on overall QoL was not significant. While this may partly be attributed to few included studies (k = 5), previous research has found that the effect of depression on QoL is greater than the effect of DM on QoL (34). Only one included study (35) was comprised of T2DM patients with comorbid depression, with the remainder of studies conducted in general T2DM populations. It is possible that had more studies included T2DM patients with comorbid depression, larger effect sizes may have been observed.

While this review adhered to the PRISMA guidelines (20) and used systematic and rigorous methods based on the Cochrane Collaborations’ recommendations (24), various limitations of the included studies suggest caution when interpreting the results. Validity, as assessed through the risk of bias (22), was unclear for the majority of included studies, predominantly due to the lack of reporting of vital information, such as allocation concealment and blinding of outcome assessors. Most studies did not follow recognized reporting standards, such as the CONSORT statement (36), and consequently, information required for an adequate risk of bias assessment was largely missing.
Additionally, publication bias was evident for two of the CBT outcomes (depression and anxiety), and the level of heterogeneity was considerable for all outcomes utilizing CBT and CCT (with the exception of depression for CCT). While this heterogeneity could not be explained despite the various subgroup analyses conducted, the heterogeneity is most probably caused by a combination of several confounding factors (e.g., clinical and methodological diversity). Furthermore, the heterogeneity observed in CBT and CCT is potentially associated with the wide range of techniques that encompassed CBT, as well as the unstructured, non-directive nature of CCT. In comparison, MI, while non-directive, is a specific technique that is focused and goal-oriented with less opportunity for variation between RCTs.
It is also worth noting that none of the included studies reported using manualized interventions or assessed treatment integrity of the psychological therapies utilized. This review tightly limited eligibility to studies comparing psychological therapies to a control condition; however, it is difficult to ascertain whether the effective component of each intervention was the psychological therapy itself, or if it was a combination of increased monitoring of individuals in each of the intervention groups. The majority of patients with T2DM in China do not regularly monitor their blood glucose concentration or attend regular appointments specifically to manage their T2DM (37, 38). Therefore, the effect size attributed to each psychological therapy may have been overestimated due to increased monitoring and attention to the health care of individuals in each intervention group rather than due to the specific psychological therapy.

The utilization of psychological therapies for behavior change in chronic disease management is a relatively new field in China, and this was reflected by the publication date of included studies (only \( k = 1 \) published before 2000). With the combination of China’s increasing T2DM burden, there is a huge potential for psychological interventions to be conducted in China. In particular, this review highlights that interventions are required that utilize specific psychological therapies (i.e., manualized CBT) and not just components of recognized therapies (i.e., relaxation training as a component of CBT). Additionally, more interventions utilizing MI and CCT would enable a more thorough assessment of outcomes of interest and would allow for heterogeneity and publication bias to be adequately investigated. In line with China’s current primary health care reform which is aiming to shift T2DM management from a hospital-based model, toward delivery in primary health care settings (39), there is a pressing need for interventions to be conducted at the community health level that utilize existing resources. In this study, the population group most frequently sampled were hospital inpatients (\( k = 38 \)), and only three of the included studies were conducted in a community health setting (one utilizing CBT and two utilizing MI). Previous research has observed differences in anthropometric, biochemical, and cardiovascular risk profiles between inpatients and outpatients (40). As such, generalizability of these findings to the community health setting is limited. Despite the recency of published articles, there were no interventions that utilized technology in the delivery of their intervention, and this is also an opportunity for further research. Finally, interventions of future RCTs in China should include longer follow-up periods and report the interventions according to the CONSORT statement (36) in order to meet international standards, to enable adequate risk of bias assessments to be performed, and to increase the rigor of future reviews.

With regard to recommendations for future systematic reviews and meta-analyses, the additional 40 RCTs identified in this review highlights the importance of intentionally utilizing language/country specific databases in future search strategies. The inclusion of more non-English publications in systematic reviews limits the potential for language bias and increases the precision and statistical power of meta-analysis estimates (41). When relevant, the use of regional databases is promoted by the Cochrane Collaboration (24), and Chinese biomedical databases are a potential resource that should be considered.

In conclusion, this systematic review and meta-analyses demonstrated that psychological interventions, namely, CBT, MI, and CCT, are effective in improving certain T2DM related outcomes in China. Considerable levels of heterogeneity and unclear risk of bias associated with the most included RCTs warrant caution when interpreting results. If China is to address the health issues associated with its burgeoning T2DM population and delay the progression of T2DM-related outcomes, psychological interventions are promising tools and should be utilized in the future.

AUTHOR CONTRIBUTIONS

AC, SM, CB, and ST contributed to the study conception and design. AC, SM, and SL did the systematic literature search. AC, SM, SL, and HY selected studies for inclusion, and SL and HY extracted the data. AC and SM assessed risk of bias of included studies. AC, SM, and JE performed the statistical analysis, interpreted data, and wrote the first draft of the manuscript. All authors critically revised the manuscript and approved the final version. All authors, internal and external, had full access to the study data and take responsibility for the integrity of the data and the accuracy of the data analysis. All authors have approved the final version of the manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at http://journal.frontiersin.org/article/10.3389/fpubh.2015.00252

REFERENCES

1. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care (2010) 33(Suppl 1):S62–9. doi:10.2337/dc10-0062

2. American Diabetes Association. Standards of medical care in diabetes – 2013. Diabetes Care (2013) 36(Suppl 1):S11–66. doi:10.2337/dc13-0011

3. Scottish Intercollegiate Guidelines Network (SIGN). Management of Diabetes: A National Clinical Guideline. Edinburgh: Scottish Intercollegiate Guidelines Network (SIGN) (2010).

4. Royal Australian College of General Practitioners. Diabetes Management in General Practice: Guidelines for Type 2 Diabetes. Melbourne: Royal Australian College of General Practitioners and Diabetes Australia. General Practice Management of Type 2 Diabetes – 2014–15 (2014).

5. Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. Clinical practice guidelines for the prevention and management of diabetes in Canada. Can J Diabetes (2013) 37(Suppl 1):S1–216. doi:10.1016/j.cjdi.2013.01.009

6. Meurs M, Roest AM, Wolfenbuttel BH, Stolk RP, de Jonge P, Rosmalen JG. Association of depressive and anxiety disorders with diagnosed and undiagnosed diabetes: an epidemiological study of 90,686 participants. Psychosom Med (2015). doi:10.1016/j.psychres.2015.07.017

7. Collins MM, Corcoran P, Perry IJ. Anxiety and depression symptoms in patients with diabetes. Diabet Med (2009) 26(2):153–61. doi:10.1111/j.1464-5491.2008.02648.x

8. Gonzalez JS, Peyrot M, McCarl LA, Collins EM, Serpa L, Mimiaga MJ, et al. Depression and diabetes treatment nonadherence: a meta-analysis. Diabetes Care (2008) 31(12):2398–403. doi:10.2337/dc08-1341
Chapman et al.  
Psychological Interventions for Type 2 Diabetes in China

57. Jiang H. Effects of systemic psychological intervention on symptom and life quality of type 2 diabetes with depression. *China J Health Psychol* (2011) 19(1):98–100. doi:10.3969/j.issn.1008-0341.2011.06.027

58. Jin S, Chen X, Mu J, Chen Z. Effect of psychotherapy on depression with type II diabetes patients. *China J Health Psychol* (2007) 15(1):94–5. doi:10.3969/j.issn.1005-1252.2007.01.030

59. Ke X, Wang Q. Effect of psychological treatment on type 2 diabetic nephropathy. *J Huangshi Inst Technol* (2012) 28(1):54–6. doi:10.3969/j.issn.1008-8245.2012.01.014

60. Li Z, Lu G, Peng A. Effect of mental therapy in the patients with type 2 diabetes. *China J Health Psychol* (2006) 14(2):212–4. doi:10.3969/j.issn.1005-1252.2006.02.026

61. Li Y, Tang S, Chen W. Effects of comprehensive psychological intervention on emotion and carbohydrate metabolism in patients with type 2 diabetes mellitus. *J Chin Gen Pract* (2008) 6(12):1279–80. doi:10.3969/j.issn.1674-4152.2008.12.040

62. Li J, Wang M, Wang R, Zhang J, Zheng Y, Long J, et al. Effect of self-management intervention on psychology and behavior of diabetic patients. *J Nurs Sci* (2009) 24(13):72–4. doi:10.3870/hlzzx.2009.13.072

63. Li M, Jiang D, Wang J. Effect of psychological cognitive nursing of type 2 diabetes with depression disorder. *Today Nurse* (2010) 8:83–4. doi:10.3969/j.issn.1006-6411.2010.08.054

64. Li M, Wang X, Ma Y, Wan A. Effects of psychological intervention on preliminary type 2 diabetics' survival quality and hospital stay. *Mod Prev Med* (2011) 38(8):1473–5.

65. Liu T, Tian J, Yan J. Effect of psychological intervention on the curative effect of the senile diabetes. *Chin J Behav Med Sci* (2000) 5:339–40. doi:10.3760/cma.j.issn.1674-6554.2000.05.008

66. Liu Y, Liu L. Systemic education and psychology interference on depression and carbohydrate metabolism of the patients with type 2 diabetes. *J Nurs Sci* (2003) 18(10):727–9. doi:10.3969/j.issn.1001-4152.2003.10.002

67. Ma Z, Li M, Wang C. Effects of comprehensive psycho-intervention on life quality and carbohydrate metabolism in patients with type 2 diabetes mellitus. *Chin J Clin Rehabil* (2006) 10(30):15–7. doi:10.3321/j.issn:1673-8225.2006.30.005

68. Peng M, Ou X, Wang X. The influence of psychological intervention on negative emotion and glucose level control of patients with type 2 diabetes. *Int J Nurs Sci* (2009) 28(1):102–5.

69. Peng Y, Jiang Y, Zhou H. Effect of personal psychological nursing on medication treatment of type 2 diabetes. *Pract Cardio Cerebr Palm Vasc Dis* (2010) 18(6):731–2. doi:10.3969/j.issn.1008-5971.2010.06.018

70. Ren M, Wei H, Gao G. Application of morita therapy and relaxation therapy in diabetes patients' health education. *J Qilu Nurs* (2007) 7:96–7. doi:10.3969/j.issn.1008-7256.2007.07.101

71. Sun F, Fang R, Cheng J. A control study of effect of comprehensive psychological intervention for patients with type 2 diabetes. *Health Psychol J* (2002) 10(6):465–6. doi:10.3969/j.issn.1005-1252.2002.06.039

72. Sun B, Ban B, Sun H. Effects of diabetes education and psychological intervention on comprehensive treatment of type 2 diabetes. *Chin J Clin Psychol* (2005) 13(4):483–5. doi:10.3969/j.issn.1005-3611.2005.04.039

73. Sun H, Zhang Q. Effects of psychological interventions on depression and glucose metabolism of low-income people with type 2 diabetes. *China Clin Pract Med* (2009) 3(11):96–7. doi:10.3760/cma.j.issn1673-8799.2009.11.62

74. Wang X, Hu W. Effects of mental therapy on anxiety depression emotions of type 2 diabetics. *J Clin Psychosom Dis* (2008) 14(5):418–9. doi:10.3969/j.issn.1672-187X.2008.05.015

75. Wang P, Han P, Zhang Y, Wang Z. Effect of nursing intervention on glucose and lipid metabolism in diabetic patients with depression. *Chin J Nurs Educ* (2010) 6(10):470–2. doi:10.3761/j.issn.1672-9234.2010.09.015

76. Wang X, Zhang J, Wang F, Li Z, Mei J. Application of motivational interviewing in community of type 2 diabetes patients' health education. *Anhui Med J* (2011) 32(12):2066–8. doi:10.3761/j.issn.1000-0399.2011.12.052

77. Wei S, Guo W, Liang Z, Yan D. Study of mental health educating in hospital effecting on type 2 diabetes mellitus patients' quality of life and glycometabolism. *J Pract Med Tech* (2008) 15(10):1236–8. doi:10.3969/j.issn.1671-5098.2008.10.007

78. Wu G, Huang P. The effect of psychological intervention on treatment of patients with diabetes. *China Med Doctor* (2008) 46(10):62–3. doi:10.3969/j.issn.1673-9701.2008.10.034

79. Xiao L, Liang T, Wei D. The effect of cognitive behavioral therapy on quality of life in type 2 diabetes. *Chin J Behav Med Sci* (2006) 15(7):591–2. doi:10.3760/cma.j.issn.1674-6554.2006.07.006

80. Yan Q, Li J. Influence of psychological counseling on type 2 diabetic patients' blood sugar level and emotion. *W China Med J* (2011) 26(9):1306–8.

81. Yang L, Zhang S, Mao Y, Wei J. Effect of psychological nursing care on disease control of patients with diabetes. *Shanxi Med J* (2009) 38(Suppl):90–1. doi:10.3969/j.issn.0253-9926.2009.01.060

82. Yi L, Zhou C. The influence of mental intervention on blood sugar in type 2 diabetes mellitus. *Med J Qilu* (2012) 27(6):529–30. doi:10.3969/j.issn.1009-149X.2012.06.027

83. Zeng Z, Ma L, Tang L, Luo G, Zhou L. Comprehensive intervention on diabetes mellitus. *Chin Ment Health J* (2003) 17(4):253–5. doi:10.3321/j.issn.1000-6729.2003.04.012

84. Zhang Z, Shan B, Wang X, Ma A, Leng Y. The effect of psychological intervention on negative emotion and glucose control of patients with diabetes. *Chin J Behav Med Sci* (2001) 10(5):452–513. doi:10.3760/cma.j.ssn.1674-6554.2001.05.025

85. Zhang Y, Zhao Y, Xu L, Hu H, Hu S. Application of motivational interviewing to diabetic education for elderly patients with type 2 diabetes mellitus. *J Nurs Sci* (2012) 27(10):8–10. doi:10.3870/hlzzx.2012.19.008

86. Zhu X, Gong Y, Yao S. The effect of biofeedback assisted relaxation training on glucose metabolism in patients with type II diabetes: a follow-up study. *Chin J Clin Psychol* (2001) 9(1):4–9. doi:10.3969/j.issn.1005-3611.2001.01.002

87. Zhu XZ, Gong YX, Yao SQ. The effect of biofeedback assisted relaxation training on cytokines in patients with type II diabetes. *Chin J Clin Psychol* (2001) 9(1):170–2. doi:10.3969/j.issn.1005-3611.2001.03.004

Conflict of Interest Statement: The authors of this manuscript declare no conflict of interest. There have been no payments or services for the work of this manuscript. There are no financial relationships with any entities that may have influenced the work of this manuscript. There are no declarations for patent or copyright for work related to this manuscript.

Copyright © 2015 Chapman, Liu, Merkouris, Enticott, Yang, Browning and Thomas. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) or licensor are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.