**Supplementary table 1** Characteristics of included studies in meta-analysis

| Author | Year | Country | Study design | Group | Intervention type | Intervention/Control properties  | N | Sex (Male/Female) | Age | Cancer type | Quality assessment | Outcomes |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ando | 2010 | Japan | RCT | short-term life-review interviews | individual  | 2 interview sessions, each last 30-60 mins with a one-week interval, review lives, along with themes in life and dignity therapy | 34 | 19/15 | 65±14 | lung, stomach, breast, liver, pancreas, and others | 4 | FACIT-SP, VAS |
|  |  |  |  | general support | - | - | 34 | 13/21 | 64±14 |  |  |
| Bordeleau | 2003 | Canada | RCT | therapist-led support group | group | weekly 90-minute therapist-led support group adhered to the principles of supportive-expressive therapy for at least 1 year or longer, educational materials every 6 months | 145 | female | 49.4±8.4 | breast | 3 | QoL-EORTCQLQ-C30 |
|  |  |  |  | control | - | educational materials about breast cancer and its treatment, relaxation, nutrition every 6 months | 70 | 51.5±10.0 |  |  |
| Breitbart | 2018 | USA | RCT | IMCP | individual  | 7-session intervention, helping patients to develop or increase a sense of meaning in lives | 109 | 28/81 | 58.1±10.2 | breast, colon/rectal, lung, ovarian, pancreatic, and others | 3 | MQOL, HADS, FACIT-Sp |
|  |  |  |  | supportive psychotherapy | group | follow an established treatment manual, encourage patients to share concerns related to diagnosis and treatment, describe experiences and emotions, identify challenges | 108 | 37/71 | 58.8±12.0 |  |  |
|  |  |  |  | enhanced usual care | - | provide a list of resources for mental health treatment + targeted referrals specific to problem areas identified on the distress thermometer, a packet of resources for coping with cancer along with a signed copy book of "The Human Side of Cancer" | 104 | 26/78 | 57.1±10.9 |  |  |
| Breitbart | 2012 | USA | RCT | IMCP | individual  | manualize 7-week intervention including 7 1-hour sessions, using didactics, experiential exercises and psychotherapeutic techniques (eg, reflection, clarification, and exploration) to promote the use of sources of meaning as resources in coping with advanced cancer | 64 | 72/48 | 54.4±11.6 | breast, colon, pancreatic, ovarian, lung | 4 | MQOL, HADS, BHS |
|  |  |  |  | therapeutic massage | - | 7 1-hour sessions with a licensed massage therapist, involving manipulation of the soft tissue of the whole body or particular areas of the body | 56 |  |  |
| Cheung | 2017 | USA | RCT | positive affect skill intervention | individual  | 5 weekly 1-hour sessions, learn 8 empirically based skills to increase the frequency of positive emotions, teach up to 3 skills and practice each skill as “home practice” every day until the next weekly session | 26 | female | 53.35±11.22 | breast | 3 | CES-D |
|  |  |  |  | control | - | 5 hourly one-on-one sessions, an interview without a didactic portion or skill practice | 13 |  |  |
| Clark | 2013 | USA | RCT | multidisciplinary intervention | group | 6 90-min sessions, starting with 20 minutes of conditioning exercises led by a physical therapist followed by education, cognitive behavioral strategies for coping with cancer, open discussion, and support, and concluding with a 15-minute deep breathing or guided imagery relaxation segment; 10 brief structured telephone counseling sessions | 65 | 41/24 | 58.7±10.6 | brain, gastrointestinal, head and neck, lung, and others | 3 | FACT-G |
|  |  |  |  | standard care | - | medical appointments and referrals to specialists | 66 | 45/21 | 59.9±10.9 |  |  |
| Classen | 2001 | USA | RCT | supportive-expressive group therapy | group | meet weekly for 90-min sessions for at least 1 year, create a supportive environment for participants to confront their problems, strengthen their relationships, find enhanced meaning in their lives | 58 | female | 52.9 ± 10.7 | breast | 3 | POMS |
|  |  |  |  | control | - | educational materials | 44 | 54.0 ± 10.7 |  |  |
| Duggleby | 2007 | Canada | RCT | LWHP | individual  | view an film entitled ‘‘Living with Hope’’, working on a hope activity over a one-week time frame, choose one of the three hope-focused activities: write or ask someone to help you write a letter to someone, begin a hope collection, or begin an "about me" collection  | 30 | 9/11 | 73.63±8.84 | - | 3 | MQOL, HHI |
|  |  |  |  | standard care | - | - | 30 | 19/11 | 76.30±9.06 |  |  |
| Edelman | 1999 | Australia | RCT | CBT | group | use of CBT, encouraging the expression of feelings, building of group support | 62 | female | - | breast | 3 | POMS |
|  |  |  |  | control | - | - | 62 | - |  |  |
| Goodwin | 2001 | Canada | RCT | supportive–expressive group | group | weekly meetings lasting 90 minutes for at least 1 year, foster support among group members and to encourage the expression of emotions about cancer and its broad-ranging effects on lives, educational materials, relaxation and nutrition  | 158 | female | 49.5±8.4 | breast | 5 | POMS, VAS |
|  |  |  |  | control | - | educational materials, relaxation and nutrition, not any psychological therapy as part of the study | 77 | 51.5±10.3 |  |  |
| Greer | 2019 | USA | RCT | CBT mobile app Intervention | individual  | deliver skills for managing cancer-related anxiety over six sessions (approximately 20–30 minutes each) through a mobile app, with corresponding homework exercises (approximately 10–15 minutes each, a seventh session to review material from prior sessions | 72 | 17/55 | 55.86±10.08 | gastrointestinal, gynecological, lung, breast, melanoma, sarcoma, genitourinary, peritoneal | 6 | HAM-A, HADS, PHQ-9 |
|  |  |  |  | health education program control | - | slide decks with voiceover accompaniment, detailing general information about the following topics: side effects of cancer treatment, exercise, nutrition, memory and cognition, sexual health, and QOL | 73 | 21/52 | 57.03±12.42 | gastrointestinal, gynecological, lung, breast, melanoma, sarcoma, genitourinary, thyroid |  |  |
| Hall | 2011 | UK | RCT | dignity therapy | individual  | dignity therapy, including the theoretical basis for the intervention, demonstrations of dignity therapy, a detailed overview of the therapy manual, editing the therapy documents and working with patients to produce a document | 22 | 9/13 | 64.91±15.96 | digestive, respiratory, soft tissue, breast, female genital, male genital, eye/brain, thyroid, lymphoid | 5 | EQ-5D, HADS, HHI, survival |
|  |  |  |  | standard palliative care | - | assessment by a multi-professional palliative care team | 23 | 13/10 | 65.30±17.91 | lip/oral, digestive, respiratory, soft tissue, breast, female genital, male genital, urinary, eye/brain, thyroid, lymphoid |  |  |
| Hansen | 2009 | USA | RCT | forgiveness therapy | individual  | once-weekly individual sessions, each lasting approximately 60 mins, including four units, each with a particular focus on the psychological variables and units of the process model of forgiveness | 10 | 2/18 | 73±7.36 | - | 3 | HHI |
|  |  |  |  | control | - | contact once weekly by telephone and last approximately 15 minutes during the four-week period, discussion of the timeline for beginning the intervention, addressing questions or concerns regarding the study, offering emotional support regarding concerns raised by the participant | 10 |  |  |
| Henry | 2010 | Canada | RCT | meaning-making intervention | individual  | meaning-making intervention, 1–4 intervention sessions of 30–90 min each, structure around three main tasks: (1) review the impact and meaning of the cancer diagnosis; (2) explore past significant life events and successful ways of coping, as related to the present cancer experience; and (3) discuss life priority and goal changes that give meaning to one’s life, while considering cancer-related limitations | 12 | female | 55±9.7 | ovarian | 5 | MQOL, HADS, FACIT-Sp |
|  |  |  |  | usual care | - | individual or group psychosocial consultations with a multidisciplinary team | 12 |  |  |
| Laely | 2018 | Indonesia | Quasy-experimental study | mindfulness meditation training | group | 6 sessions for 3 weeks, including an introductory session and an exploration of experience, mindfulness sensory and emotional exercises with body scanning and self-conscious mindfulness exercises | 16 | 12/4 | 46.4±12.6 | nasopharyngeal | 16 | HAM-A, VAS |
|  |  |  |  | control | - | radiation service from the hospital | 17 | 11/6 | 48.9±11.4 |  |  |
| Lloyd-Williams | 2018 | UK | RCT | focused narrative intervention | individual  | a single semi-structured narrative face to face interview, lasting 25-60mins, helping patients to reflect on their own inner resources and coping methods | 33 | 18/39 | 66.2 | breast, gastrointestina, lung, male-specific, female-specific, and others | 4 | PHQ-9 |
|  |  |  |  | usual care | - | antidepressant medication, access to complementary therapies, counselling | 24 | 63.4 | breast, gastrointestina, lung, head/neck, male-specific, female-specific, and others |  |  |
| Moorey | 2009 | UK | RCT | CBT | individual  | some CBT focused on emotional problems as part of the home consultation | 45 | - | 65.0±12.6 | breast, colon, head and neck, lung, ovary, oesophagus, pancreas, rectum, stomach, and others | 3 | survival |
|  |  |  |  | usual treatment | - | - | 35 | 62.3±12.7 |  |  |
| Nikbakhsh | 2018 | Iran | RCT | supportive group psychotherapy | group | psychotherapy classes for 8 weeks, at least 45 minutes in each session, helping patients to better adapt to the environment | 20 | female | 49.7±8.7 | breast | 1 | HADS |
|  |  |  |  | citalopram | - | 20-40 mg/day for 12 weeks | 20 | 49.4±12.4 |  |  |
| Northouse | 2005 | USA | RCT | family based intervention | individual  | consist of 5 core content areas: family involvement, attitude, coping effectiveness, uncertainty reduction, symptom management. masters-prepared nurse conduct 3 home visits, space one month apart (approx. 90min/visit), two prearranged follow-up phone calls to both the patient and family caregiver (approx. 30min/call) | 69 | female | 54±11 | breast | 3 | BHI, Brief COPE |
|  |  |  |  | usual care | - | - | 65 |  |  |
| Northouse | 2013 | USA | RCT | brief home-based dyadic intervention | individual  | two 90-min home visits and one 30-min phone session, 10 weeks in duration; address five content areas related to the acronym FOCUS: family involvement, optimistic attitude, coping effectiveness, uncertainty reduction, and symptom management | 159 | 187/297 | 60.5±10.9 | breast, colorectal, lung, prostate | 3 | BHI, Brief COPE |
|  |  |  |  | extensive home-based dyadic intervention | individual  | four 90-min home visits and two 30-min phone sessions, 10 weeks in duration; address five content areas related to the acronym FOCUS: family involvement, optimistic attitude, coping effectiveness, uncertainty reduction, and symptom management | 162 |  |  |
|  |  |  |  | usual care | - | medical treatment of cancer and symptom management, provide psychosocial support occasionally but not routinely | 163 |  |  |
| Peng | 2019 | China | RCT | supportive group psychotherapy | group | 90 mins’ group psychotherapy intervention weekly for 8 weeks; create a sense of belonging and normalcy, sharing and reshaping their identities, feeling a sense of mutual aid, and creating hope by comparison of coping success | 82 | 42/40 | 61.4±9.2 | lung | 3 | QoL-EORTCQLQ- C30 |
|  |  |  |  | usual care | - | - | 78 | 43/35 | 59.4±8.3 |  |  |
| Rodin | 2018 | Canada | RCT | CALM | individual  | three to six CALM psychotherapy sessions (each 45 to 60 mins) over 3 to 6 months, provides a therapeutic relationship and reflective space, with attention to the following domains: symptom management and communication with health care providers, changes in self and relations with close others, spiritual well-being and the sense of meaning and purpose, and mortality and future-oriented concerns. | 151 | 61/90 | 59.05±10.55 | breast, lung, sarcoma, melanoma, endocrine, gastrointestinal, gynecologic, genitourinary | 5 | PHQ-9, FACIT-Sp |
|  |  |  |  | usual care | - | routine oncology treatment and follow-up and clinic-based distress screening, not preclude referral for specialized psychosocial oncology services, but most patients with metastatic cancer at PM do not receive psychotherapy as part of UC | 154 | 62/92 | 59.10±11.48 |  |  |
| Rost | 2012 | USA | RCT | ACT | individual  | meeting with a therapist on 12 occasions for 1 hour, over the course of a 4-month period; to help women cope with ovarian cancer and the emotional distress | 25 | female | 56 (32-74) | ovarian | 4 | FACT, BDI-II |
|  |  |  |  | usual care | - | - | 22 |  |  |
| Savard | 2006 | Canada | RCT | cognitive therapy | individual  | administered individually, involve 8 weekly sessions of 60 to 90 min, 3 booster sessions every 3 weeks following treatment, including presentation of a cognitive theory of emotions, increase level of daily activities, identify negative thoughts, use cognitive restructuring to modify dysfunctional or irrational cognitions in their life, redefine their life goals  | 21 | female | 51.47±8.05 | breast | 5 | HADS, BDI-II |
|  |  |  |  | waiting-list control | - | waited for a period corresponding to the duration of the intervention (8 weeks) | 16 | 51.66±8.62 |  |  |
| Serfaty | 2020 | UK | RCT | CBT | individual  | 12 sessions of individual CBT, usually weekly and within 3 months, either face to face or by telephone | 115 | 41/74 | 59.5±10.3 | breast, haematological, comprising myeloma, lymphoma, leukaemia, colon, lung, prostate, and others | 4 | EQ-5D, BDI-II, PHQ-9 |
|  |  |  |  | usual care | - | routine assessment and treatment, including care from general practitioners (GPs), clinical nurse specialists, oncologists and palliative care clinicians | 115 | 37/78 | 59.5±12.4 |  |  |
| Spiegel | 1983 | USA | RCT | psychological support group | group | assign to one of two cancer support groups, weekly 90-minute outpatient group meetings at 4-month intervals for a total period of one year; involve sharing of mutual fears and concerns | 34 | female | 54 | breast | 3 | VAS |
|  |  |  |  | control | - | regular oncological treatment but no additional psychological support | 24 | 55 |  |  |
| Steel | 2016 | USA | RCT | web-based stepped collaborative care | individual  | access to a psychoeducational web site and to a collaborative care coordinator with cognitive-behavioral therapy (CBT) and psycho-oncology, telephone contact with care coordinator every 2 weeks, face-to-face contact with care coordinator in the oncology outpatient clinic and/or hospital approximately every 2 months | 144 | 190/71 | 61±11 | hepatocellular carcinoma and cholangiocarcinoma, other primary cancers with liver metastases | 5 | FACT, CES-D, BPI |
|  |  |  |  | enhanced usual care | - | usual care provided by the medical team + assessment of symptoms and blood draws | 117 |  |  |
| Szpringer  | 2018 | Poland | Quasy-experimental study | EMDR | individual  | EMDR therapy with an average length of the therapy of around 14 weeks, 12–14 therapeutic weekly sessions lasting 60–90 mins | 18 | female | 63 (52-75) | glioblastoma multiforme | 15 | HADS |
|  |  |  |  | control | - | - | 19 | 65.5 (53-79) |  |  |
| Tang | 2019 | China | RCT | advance care planning | individual  | facilitation of physician patient end-of-life care discussions, use of a booklet and video educational aid to facilitate understanding of advance care planning and life-sustaining treatments at end-of-life, psychological support of participants while engaged in end-of-life care decision-making, interactions weekly during hospitalization, or monthly at outpatient clinics | 215 | 156/59 | - | liver, gastrointestinal tract, esophagus, pancreas, lung, and others | 7 | survival |
|  |  |  |  | control | - | a sham treatment of symptom-management education weekly during hospitalization or monthly at outpatient visits | 215 | 147/68 | - |  |  |
| Teo | 2020 | Singapore | RCT | CBT-MV | individual  | four, 1-hour in-person individual sessions in an outpatient setting within 8 weeks, included a combination of psycho‐education, skills training for symptom management, mindfulness techniques, values clarification, and value‐guided action planning | 44 | female | - | breast | 3 | HADS, BPI |
|  |  |  |  | standard care | - | - | 41 |  |  |
| Walshe | 2020 | UK | RCT | peer mentor | individual  | trained peer mentors initiated informal contact with the patient ≤ 2 times per week, either face-to-face or by telephone, the content individually tailored to individual needs and circumstances, but capped at ≤ 2h | 6 | 3/3 | 64.8±6.2 | bowel, prostate, breast, and others | 4 | EORTC-QLQ- C15‑Pal, PHQ-9 |
|  |  |  |  | usual care | - | any health or social care accessed by patient participants during the study | 6 | 4/2 | 69.6±9.7 | bowel, ovarian, head and neck, prostate, and others |  |  |
| Zaki-Nejad  | 2020 | Iran | Quasy-experimental study | dignity therapy | individual  | three 30–60 minutes sessions, guided the participants with the help of specific questions form of the dignity therapy protocol | 25 | 23/27 | 52.56±10.22 | breast, gastric, lung, colorectal, gynaecological, urological and nephrological, and others | 15 | QoL-EORTCQLQ- C15‑Pal |
|  |  |  |  | usual care | - | - | 25 |  |  |
| Zhang | 2018 | China | RCT | comprehensive care | individual  | comprehensive care, including health education and psychological intervention; learn to reasonably cope with the situations, correct their self-concepts, arouse their initiatives, correct their mistakes with rational cognition, and reconstruct cognitive structure; also receive progressive relaxation trainings; specialized tailored psychological counseling was implemented to the individuals with negative emotions and at high risks in accordance with their personal traits | 70 | 53/17 | - | non-small cell lung cancer, small cell lung cancer | 3 | QoL-EORTCQLQ- C30 |
|  |  |  |  | usual care | - | management of artificial airway, chemotherapy-related adverse events, other symptomatic management | 70 | 50/20 | - |  |  |

RCT, randomized controlled trial; N, number, IMCP, individual meaning-centered psychotherapy; LWHP, living with hope program; CBT, cognitive‐behavioral therapy; CALM, Managing Cancer And Living Meaningfully; ACT, acceptance and commitment therapy; EMDR, Eye Movement Desensitization and Reprocessing; CBT-MV, CBT symptom management intervention + ACT mindfulness and values‐guided principles; MQOL, McGill Quality of Life Questionnaire; FACT-G, Functional Assessment of Cancer Therapy; EORTC‑QLQ‑C15‑Pal, European Organization for Research and Treatment of Cancer Quality of life-C15-Palliative; EQ-5D, EuroQol 5 Dimensions; QoL-EORTCQLQ- C30, European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-Core 30; HAM-A, Hamilton Anxiety Rating Scale; HADS, Hospital Anxiety and Depression Scale; BDI-II, Beck Depression Inventory-II; CES-D, Center for Epidemiologic Studies Depression Scale; PHQ-9, Patient Health Questionnaire 9; FACIT-Sp, Functional Assessment of Chronic Illness Therapy-Spiritual Well-Being Scale; HHI, Herth Hope Index; BHS, Beck Hopelessness Scale; POMS, Profile of Mood States; VAS, Visual Analogue Scale; BPI, Brief Pain Inventory.

**Supplementary table 2 Power of the analysis of relationship between psychotherapy and outcomes**

| **Outcomes** | **Power (%)** |
| --- | --- |
| **QOL** |  |
| MQOL | 73.90 |
| FACT-G | 71.27 |
| EORTC‑QLQ‑C15‑Pal | 99.75 |
| EQ-5D | 17.27 |
| QoL-EORTCQLQ- C30 |  |
| Global health | 44.87 |
| Constipation | 99.10 |
| **Survival** | 28.08 |
| **Mood** |  |
| HAM-A | 40.70 |
| HADS | 　 |
| Anxiety | 97.68 |
| Depression | 99.16 |
| BDI-II | 43.37 |
| CES-D | 66.66 |
| PHQ-9 |  |
| Total score | 27.49 |
| Score reduction ≥ 5 | 91.91 |
| FACIT-Sp |  |
| Total score | 5.94 |
| Meaning + peace score | 100.00 |
| HHI | 29.53 |
| BHS | 7.23 |
| Brief cope | 　 |
| Active coping | 13.63 |
| Avoidant coping | 13.54 |
| POMS |  |
| Confusion | 35.59 |
| **Symptom** |  |
| VAS |  |
| Pain | 55.96 |
| Suffering | 48.49 |
| BPI | 8.45 |

QOL, quality of life; MQOL, McGill Quality of Life Questionnaire; FACT-G, Functional Assessment of Cancer Therapy; EORTC‑QLQ‑C15‑Pal, European Organization for Research and Treatment of Cancer Quality of life-C15-Palliative; EQ-5D, EuroQol 5 Dimensions; QoL-EORTCQLQ- C30, European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-Core 30; HAM-A, Hamilton Anxiety Rating Scale; HADS, Hospital Anxiety and Depression Scale; BDI-II, Beck Depression Inventory-II; CES-D, Center for Epidemiologic Studies Depression Scale; PHQ-9, Patient Health Questionnaire 9; FACIT-Sp, Functional Assessment of Chronic Illness Therapy-Spiritual Well-Being Scale; HHI, Herth Hope Index; BHS, Beck Hopelessness Scale; POMS, Profile of Mood States; VAS, Visual Analogue Scale; BPI, Brief Pain Inventory.