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Bryant, Jamie; Mansfield, Elise; Hall, Alix; Waller, Amy; Boyes, Allison; Jayakody, Amanda; Dodd, Natalie; Sanson-Fisher, Rob "The psychosocial outcomes of individuals with hematological cancers: are we doing enough high quality research, and what is it telling us?" Published in Critical Reviews in Oncology/Hematology Vol. 101, p. 21-31 (2016)

Available from: http://dx.doi.org/10.1016/j.critrevonc.2016.02.016

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Accessed from: http://hdl.handle.net/1959.13/1326532

The psychosocial outcomes of individuals with hematological cancers: Are we doing enough high quality research, and what is it telling us?

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Keywords: psychosocial, adjustment, hematological cancer, systematic review

Word count: 3,180

ABSTRACT

This systematic review assessed the quantity and quality of research examining the psychosocial outcomes among hematological cancer patients. Studies were categorised as either measurement, descriptive or intervention. Intervention studies were further assessed according to Effective Practice and Organisation of Care (EPOC) methodological criteria. A total of 261 eligible papers were identified. The number of publications increased by 8.8% each year (95% CI = 7.5% - 10.2%; $p < 0.0001$). The majority of studies were descriptive (n=232; 89%), with few measurement (n=8; 3%) and intervention (n=21; 8%) studies identified. Ten intervention studies met EPOC design criteria, however only two interventions, one targeted at individuals with Hodgkin's or Non-Hodgkin's lymphoma and one targeted at individuals with leukaemia, lymphoma or myelomatosis were successful in improving patients' psychosocial outcomes. Despite an increasing volume of research examining psychosocial outcomes of hematological cancer patients, there is a need for robust measurement and methodologically rigorous intervention research in this area.

1. INTRODUCTION

1.1 Hematological cancers are associated with sub-optimal psychosocial outcomes

Hematological cancers are a diverse group of cancers that primarily affect the blood and bone marrow. They are typically categorised into three main disease groups: leukemias, lymphomas and myeloma[1]. Within each of these disease groups there are a range of different sub-types, each differing in their presentation, progression and treatments. Some forms are acute and highly aggressive, requiring urgent and intensive treatments, which often results in long periods of hospitalisation and a number of debilitating side effects[1]. While other forms are slow growing and chronic, which may only require monitoring or less intensive treatments[1].

As a result of a diagnosis of hematological cancer and the resulting treatment, patients and their families experience a range of psychological, social and emotional challenges. Prevalence of psychosocial distress, anxiety and depression among hematological cancer patients and survivors has been found to be higher than that reported by survivors of some other cancer types[2, 3]. A recent study by Linden and colleagues[4] found that rates of clinical and sub-clinical anxiety among hematological cancer patients were 48% and 23% respectively, and rates of clinical and sub-clinical depression were 38% and 17% respectively. In another large study of non-Hodgkin's lymphoma survivors, 39% of those surveyed reported at least one cluster of cancer-related symptoms of post-traumatic distress, 8% reported all three possible clusters of post-traumatic stress disorder symptoms[5] and 37% reported persistent or worsening symptoms five years later.[6] Similar to survivors of other cancer types[7], fear of cancer recurrence and uncertainty have been identified as common concerns of hematological cancer survivors.[8, 9] Many hematological cancer survivors also experience a range of social consequences as a result of their cancer, including taking time off work; decreased income; missing family events, children's activities, social or religious activities; difficulty paying bills and using up savings.[10] The psychosocial wellbeing of individuals affected by cancer is important because of its association with poorer quality of life, more intense physical symptoms, increased functional impairment and poor treatment adherence.[11, 12]

1.2 The contribution of research in reducing the psychosocial impact of hematological cancer

To improve important health outcomes and develop the best possible evidence for addressing psychosocial outcomes for hematological cancer survivors, there is a need for methodologically rigorous research. As measurement research is key to accurately assessing the extent and nature of a problem, research should firstly focus on developing sound, psychometrically robust psychosocial outcomes measures. Once valid and reliable measures are available, research should focus on undertaking well-designed descriptive studies to provide an understanding of the prevalence and factors associated with the problem of interest. Such descriptive research can also provide information to assist in determining areas amenable to intervention. Finally, rigorous intervention studies should then be conducted to provide causal evidence about the most effective strategies for delivering best practice healthcare. However, intervention studies must meet minimum standards of scientific quality to ensure adequate internal and external validity.

In order to reduce the adverse impact of cancer on individuals who are diagnosed with a hematological cancer, there is a need for knowledge about the prevalence and causes of sub-optimal psychosocial outcomes, and effective strategies that can be implemented to improve them. Examining the number and type of measurement, descriptive and intervention publications in a particular field over time provides a broad indication of research capacity.[13, 14] Such examination in other fields of research has found a lack of intervention research comparative to descriptive research. Further, assessing the methodological quality and effectiveness of interventions provides an indication of the strength of evidence available and identify strategies that may be successfully implemented to improve psychosocial outcomes in this population. [15, 16] Despite the significant psychosocial burden associated with hematological cancer, the volume, scope and quality of research output related to psychosocial outcomes among hematological cancer patients is unknown. Understanding the current state of research in this area will help to determine current research gaps, and to prioritise the type of research required for improving the psychosocial outcomes of this unique and growing population.

1.3 Aims

This systematic review aims to examine:

1. The volume of data-based publications examining psychosocial outcomes among hematological cancer patients at any phase of the cancer trajectory from diagnosis to end of life;

2. The proportion of measurement, descriptive and intervention research that has been carried out;
3. The methodological quality of intervention research according to the Effective Practice and Organisation of Care (EPOC)[17] methodological criteria; and
4. The effectiveness of interventions in improving psychosocial outcomes for hematological cancer patients.

2. METHODS

2.1 Definitions

There are varying conceptual underpinnings and definitions of psychosocial outcomes.[18] For this review, psychosocial outcomes were conceptualised as incorporating both psychological and social domains.[18, 19] "Psychological" included common emotional and mental health outcomes including depression, anxiety and distress.[20] Distress was defined as any unpleasant emotional experience[21] and therefore also included outcomes related to mood, emotion or stress.[20] "Social" included the following outcomes: financial, employment, legal, family and social relationships, recreation and social support[22, 23]. Quality of life was not included as a psychosocial outcome as it is a broad concept encompassing multiple dimensions which includes assessment of physical, psychological and social concerns.

2.2 Literature search

Medline, Embase, PsychInfo and Cochrane Library of Critical Reviews electronic databases were searched from inception of each database to December 2014 using subject headings and keywords. The search strategy for each of the databases is outlined in Additional File 1. Searches were restricted to human studies published in English. Books, conference abstracts and proceedings, editorials, letters, case reports and notes were excluded. The reference lists of all eligible intervention studies were manually searched to identify any other relevant studies.

2.3 Inclusion and exclusion criteria

Studies were included if they: (i) examined psychosocial outcomes as defined above; (ii) examined these outcomes among hematological cancer patients at any stage of the cancer trajectory from diagnosis to end of life; and (iii) included a sample of patients who were 15 years of age or over. Studies that included a heterogeneous sample of cancer patients including hematological cancers, were included if they reported outcomes separately for

hematological cancer patients; or reported on a sample comprising at least 90% hematological cancer patients. Studies were excluded if they: (i) were review articles, case studies, commentaries, conference abstracts, editorials or protocol papers; (ii) included individuals diagnosed with a hematological cancer in childhood; (iii) examined quality of life outcomes only; or (iv) examined psychosocial outcomes as predictor variables only.

2.4 Data coding

The abstract and title of retrieved articles were initially assessed against the eligibility criteria by one reviewer and rejected if the study did not meet inclusion criteria. The remaining full-text studies were assessed against the inclusion criteria by one author, and studies which met all criteria were retained. A random sample of 20% of studies was coded independently by another author. Discrepancies between the two authors were resolved through discussion, with a third author called upon where discrepancies could not be resolved.

Studies were categorised as either measurement, descriptive or intervention. Measurement studies reported on the development and/or psychometric properties of tools to assess psychological outcomes in hematological cancer populations. Descriptive studies reported on the prevalence and/or correlates of psychosocial outcomes among hematological cancer patients. Qualitative studies were included in this category if they described psychosocial outcomes defined in the inclusion criteria. Intervention studies tested the effectiveness of an intervention that had a primary or secondary aim of improving psychosocial outcomes in hematological cancer patients. Intervention studies were further assessed according to Effective Practice and Organisation of Care (EPOC) design criteria. Those studies that met design criteria were assessed against the EPOC risk of bias criteria[24] independently by two authors, with discrepancies resolved through discussion. To assess intervention effectiveness, study data was extracted for studies that met EPOC design criteria. Data was extracted by two reviewers and included: sample characteristics (sample size, gender, age, diagnosis); inclusion and exclusion criteria; intervention design; outcome measures; follow-up periods and study findings.

2.5 Data analysis

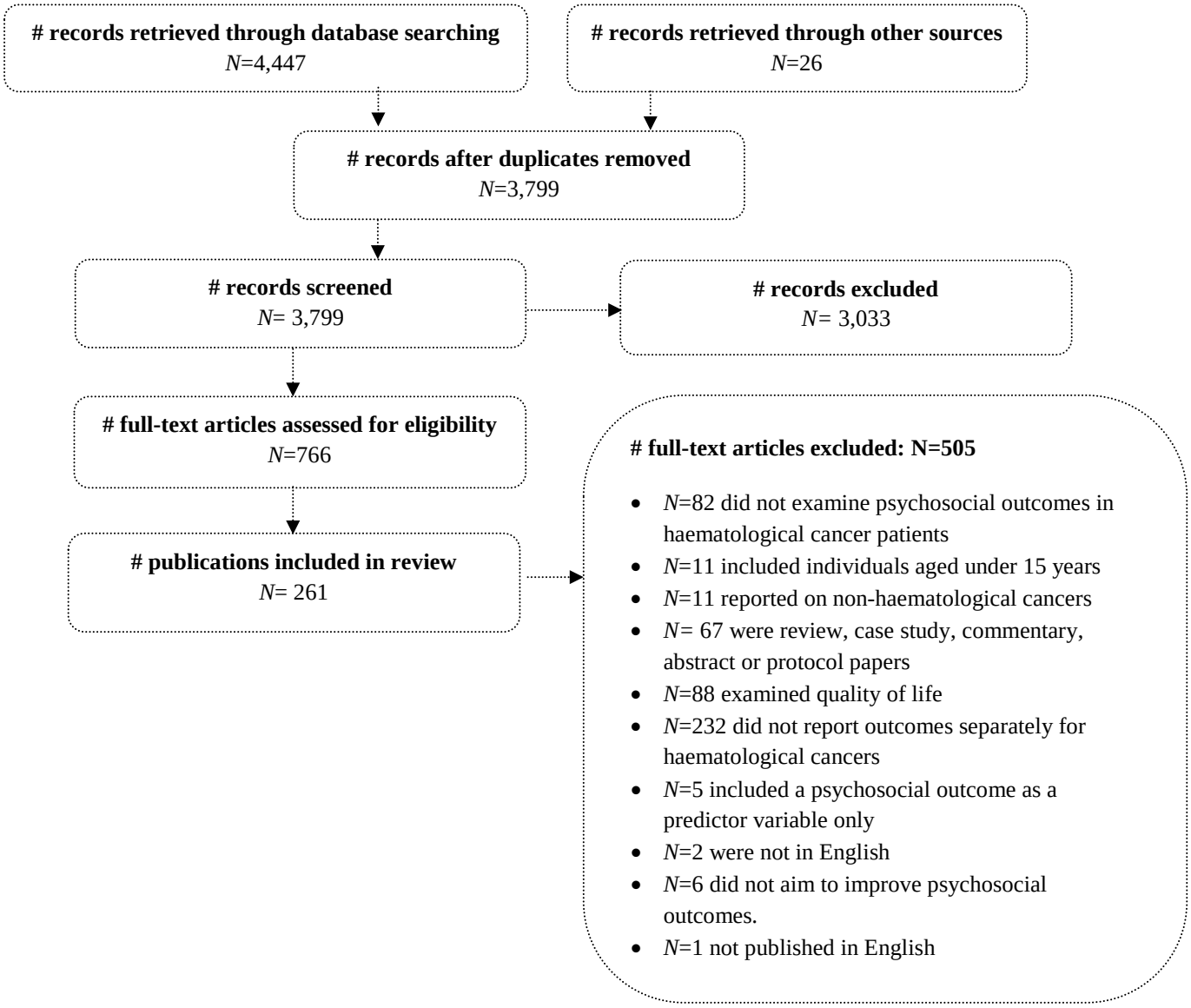
Poisson regression was used to model trends over time in the numbers of publications. Percent change by year with Wald 95% confidence are presented. P-values were calculated from the Wald Chi-square.

3. RESULTS

3.1 Search Results

The initial search yielded 4,447 results. After removal of duplicates and assessment against eligibility criteria, 261 unique publications met criteria for inclusion in the review. A flow chart of the literature search and paper identification is provided in Figure 1.

Figure 1. Flow chart of search strategy and article selection.

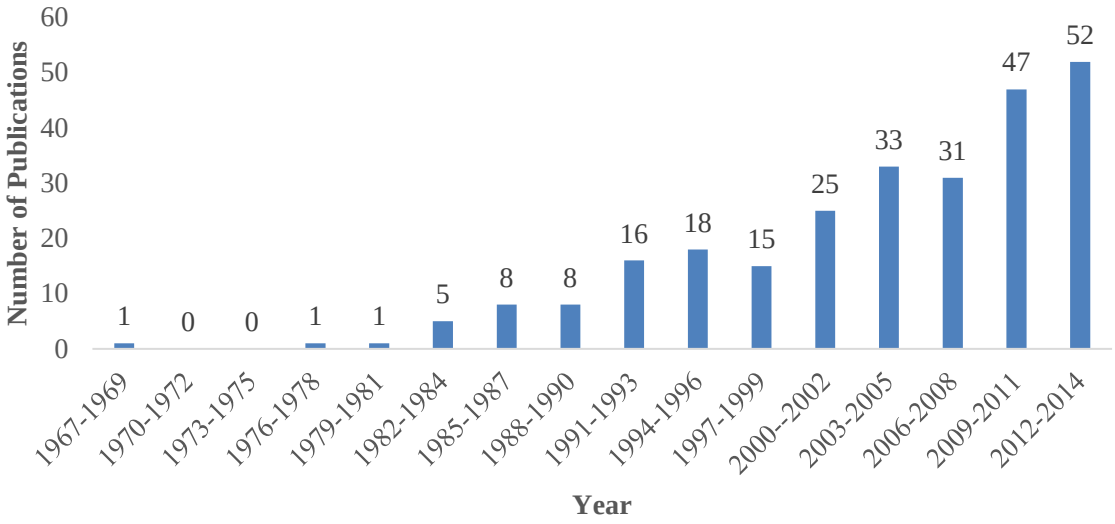


3.2 Number and type of studies over time

Figure 2 shows that the number of publications assessing psychosocial outcomes among hematological cancer patients increased over time. Poisson regression shows evidence of the

number of publications increasing by 8.8% each year (95% CI = 7.5% - 10.2%; p < 0.0001). The majority of the 261 eligible studies were descriptive studies of psychosocial outcomes (89%; n=232). In contrast, only 21 studies (8%) reported on interventions designed to improve psychosocial outcomes and eight studies (3%) reported on the development or psychometric properties of a scale designed to measure psychosocial outcomes in hematological cancer patients.

Figure 2. Number of publications over time (n=261)



3.3 Study Characteristics

Of the 21 intervention studies, 10 met EPOC design criteria. The characteristics of these studies are provided in Table 1. The majority of studies were conducted in the USA[25-30] (n=6), while the remainder were conducted in Canada[31], Germany[32], Denmark[33] and Norway[34]. Of these interventions, two reported on the effectiveness of pharmacological interventions[25, 26]; two were physical activity interventions[30, 31]; three were psychotherapeutic interventions which included cognitive behavioural techniques[32] or music therapy[28, 29]; and one was a system-based intervention that allowed the patient to communicate their concerns to clinicians prior to appointments[34]. A further two studies were multi-component interventions that included both physical activity and psychotherapy components[27, 33]. Half of the studies included samples comprising a variety of hematological cancer diagnoses[28, 29, 32-34], three interventions targeted individuals diagnosed with lymphoma[26, 27, 31] and one study

each targeted individuals with multiple myeloma[30] and myelodysplastic syndrome[25]. Study outcomes included anxiety, depression, affect, mood disturbance, psychological distress, and need for social support. Psychosocial outcomes were specified as secondary outcomes in two studies[31, 33]; the remaining studies did not articulate which outcomes were primary and secondary endpoints. The length of follow-up varied between studies, from a single follow-up immediately after the intervention[29] to follow-ups occurring up to 6 months later[25, 31, 33].

3.4 Methodological quality of intervention studies

The methodological quality of included studies according to EPOC risk of bias criteria is shown in Table 2. Five of the 10 EPOC studies were randomised controlled trials (RCTs), while the remainder were classed as controlled clinical trials (CCTs) as they did not adequately define a method of randomisation. Two studies[27, 32] were rated as low risk of bias on 8 of the 9 criteria. The remaining studies suffered from a range of methodological limitations. The most common limitations were: not adequately reporting on a method of allocation concealment[25, 26, 28-30]; failing to adequately address differences in the outcome measure at baseline [25, 26, 30, 33, 34] ; and not specifying whether outcome measures were assessed blindly[25, 27-30, 32, 33]. Further, three studies[26, 28, 30] did not account for differences in baseline demographics, one study[28] did not adequately address missing data, while another study[34] showed a high risk of contamination. Finally, one study[31] was rated as being susceptible to bias due to instructions provided to the control group.

3.5 Effectiveness of interventions in improving psychosocial outcomes

3.5.1 Pharmacological interventions. Interventions that used pharmacological treatments were not effective in improving psychosocial outcomes. In one study, Kornblith et al[25] compared Azacytidine plus supportive care with supportive care only for people with myelodysplastic syndrome and found significantly greater improvements in positive affect and distress for the intervention compared to the control group. However after controlling for baseline transfusions, the between-groups difference in distress did not reach significance. Wolanskyj et al[26] examined the effect of administering lorazepam and hydromorphone prior to bone marrow biopsy and aspiration for individuals diagnosed with Hodgkin's or Non-Hodgkin's lymphoma. There was no difference in anxiety or depression between groups from baseline to 24 hour follow-up.

3.5.2 Physical activity interventions. Interventions that used a physical activity program showed mixed effectiveness in improving psychosocial outcomes. Courneya et al[31] reported on an intervention that included supervised graded aerobic exercise training for individuals with Hodgkin's and Non-Hodgkin's lymphoma. Participants in the intervention group showed significant increases in happiness and decreases in depression, but no change in anxiety. However, in another study that used an unsupervised home-based aerobic and strength training program for individuals diagnosed with multiple myeloma, there was only a non-significant reduction in mood disturbance for both groups[30].

3.5.3 Psychotherapeutic interventions. Interventions that included only psychotherapeutic components were largely ineffective. David et al[32] reported on a web-based self-help intervention that included assessments of stress and behaviour, cognitive behavioural strategies, coping strategies, expressive writing and email support with a psychologist. The intervention was targeted at individuals with a variety of hematological cancer diagnoses, including chronic and acute myeloid leukemia; myelodysplastic syndrome and acute lymphoblastic leukemia. There were no significant differences between groups in distress at follow-up. Music therapy interventions also showed limited or no effectiveness. Burns et al[28] reported on a music imagery intervention which also incorporated relaxation for patients with acute leukemia or high-grade non-Hodgkin's lymphoma undergoing treatment in a protective environment. There was no evidence that the intervention group showed improved affect or anxiety compared to the control group, however patients in the intervention group with low negative affect at baseline showed lower anxiety at discharge than the control group. In another study that included individuals with any hematological malignancy [29], patients listened to music as they underwent bone marrow biopsy. There was no significant difference in anxiety between intervention and control groups post-intervention.

3.5.4 System-based interventions. Ruland et al[34] examined the effectiveness of a computer-assisted patient assessment tool that allowed patients with leukemia, lymphoma and myelomatosis to communicate their symptoms and any concerns to clinicians prior to inpatient stays or outpatient appointments during treatment and follow-up. Psychological symptom distress showed no reduction over follow-up time points for the intervention group. However, the need for support for mood/feelings and relationships decreased significantly for the intervention group compared to the control group.

3.5.5 Multi-component interventions. Interventions that combined a physical activity component with psychotherapeutic or psychoeducational components were also ineffective despite this more comprehensive approach. Jarden et al[33] reported on an intervention that incorporated an exercise program, progressive relaxation and psycho-education which was delivered daily during hospital admission for individuals with a variety of hematological cancer diagnoses. This intervention failed to produce any significant between-group differences in anxiety or depression at follow-up. Cohen et al[27] reported on a Tibetan yoga intervention that also incorporated controlled breathing and mindfulness for individuals with lymphoma. There were no differences in distress, anxiety or depression between intervention and control groups at follow-up.

4. DISCUSSION

Hematological cancer patients experience a high degree of distress, anxiety and depression, along with a range of social issues[2, 3, 10]. This systematic review aimed to examine the volume and type of research conducted to date, as well as the quality and effectiveness of interventions in improving the psychosocial outcomes of hematological cancer patients.

4.1 Volume of research over time and by study type

The increase in the number of publications examining psychosocial outcomes in hematological cancer patients over time reflects an increased focus on this area. However, of the 261 included publications, the vast majority were descriptive. Only 8% of studies reported on an intervention designed to improve psychosocial outcomes, while only 3% of studies reported on the development or psychometric properties of a tool designed to measure psychosocial outcomes. While knowledge about areas of psychosocial distress in hematological cancer patients is increasing, this trend suggests knowledge is not being translated to develop new interventions to alleviate this distress. The small number of measurement studies also indicates that there are few specific tools available to reliably and validly measure psychological and social burden in hematological cancer patients.

4.2 Methodological quality of intervention studies

Less than half of the intervention studies met the EPOC design criteria. Of the ten studies that did, only five were RCTs. These studies reported on pharmacological, physical activity, psychotherapeutic and system-based interventions. The methodological quality of these

studies was variable. Only two studies were rated as methodologically sound on all but one of the criteria. Recurring limitations in the remainder of the studies included failing to report a method of allocation concealment, not adequately addressing differences in the outcome measure at baseline, and failing to specify whether outcome measures were assessed blindly. These limitations weaken the evidence base.

4.3 Effectiveness of included interventions

Only two interventions were successful in improving selected psychosocial outcomes. In one study[31], participants who received supervised graded exercise training reported increases in happiness and reductions in depression. However, in this study the control group were explicitly asked not to exercise above baseline, compromising the strength of evidence. In another study[34], a patient assessment tool that provided information about patient symptoms and concerns to clinicians prior to appointments produced reductions in mood and unmet relationship needs. Additionally, half of the identified intervention studies included samples comprised of a variety of hematological cancer diagnoses. Hematological cancers are a diverse group of cancers which vary in etiology, prognosis, treatment and survival. It is therefore reasonable to expect that psychosocial impact would vary depending upon the intensity of treatment and prognostic outcomes. These findings underscore the need for continued methodologically rigorous assessments of intervention effectiveness, taking into account differences in the prognostic and treatment pathway by hematological cancer type. Future interventions may benefit from drawing on the large body of descriptive research, which may allow for tailoring components to target the specific types of psychosocial burden experienced by hematological cancer patients, as well as variations in psychosocial outcomes across the cancer trajectory. Development of interventions may also be guided by promising strategies identified in this review, as well as strategies which have shown potential to improve psychosocial outcomes in other cancer types.

4.4 Limitations

This review only included papers published in peer-reviewed journals. However, it is unlikely that rigorous studies offering high quality evidence would have been found in sources that were not peer reviewed. Many studies reported psychosocial outcomes in addition to other outcomes (such as physical functioning and physical capacity). Few studies clearly identified which of the outcomes assessed were the primary and secondary endpoints, and upon which

endpoints power calculations were based. Therefore, it is possible that some studies may not have been adequately powered to detect differences in psychosocial outcomes.

4.5 Conclusions

Prevalence of psychosocial concerns has been found to be higher for patients with hematological cancers relative to other cancer types. However, despite a growing body of literature on the extent and type of these concerns, little has been done to effectively alleviate psychosocial burden in these patients. The design of future interventions should draw on descriptive research and potentially adapt successful strategies that have been used with other cancer patient populations.

Conflict of interest statement

All authors declare they have no conflict of interests.

Acknowledgements

This research was supported by a Strategic Research Partnership Grant from the Cancer Council NSW to the Newcastle Cancer Control Collaborative, a Cancer Institute Evidence into Practice Grant (10/THS/2-14) and infrastructure funding from the Hunter Medical Research Institute.

Author contributions

JB, RSF and AH conceptualised the review. All authors contributed to the development of the review concept and logic. JB, EM, AH, AW, ND and AJ undertook data extraction. All authors contributed to drafting the manuscript and all authors approve the final version.

Vitae

Dr Jamie Bryant is an Australian Research Council (ARC) Post-Doctoral Industry Fellow and a member of the Health Behaviour Research Group and the Priority Research Centre for Health Behaviour, University of Newcastle. Dr Bryant's research has focused on behavioural health issues related to cancer prevention, with a special emphasis on addressing the needs of vulnerable population groups.

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Table 1. Characteristics of included intervention studies (n=10).

Reference Country Design	**Sample** N; Age; Gender; Diagnosis	**Eligibility** Inclusion criteria; Exclusion criteria	**Intervention**	**Outcome measures and time points**	**Findings**
PHARMAOLGICAL INTERVENYTIONS					
Kornblith et al., 2002 USA CCT	N=191 Age: I: M=67.3±10.4; C: M=67.9±10.3. % Male: I: 73; C: 65. Diagnosis: Myelodysplastic Syndrome	Inclusion criteria: Diagnosis of Myelodysplastic Syndrome; ≥16 years of age; ECOG-PS 0-2; no other serious medical or psychiatric illness. Exclusion criteria: None	Intervention: n=99. Supportive care (transfusions, antibiotics, hospitalisations) and Azacytidine.(75 mg/m^2 for 7 days administered every 28 days for a minimum of 4 months) Control: n=92. Supportive care (transfusions, antibiotics, hospitalisations)	Measures: *Primary:* QoL (EORTC-QLQ-C30), Mental health (MHI), Patient perception of improvement in condition (VAS) Follow up: Days 50, 106 and 182.	• *Primary endpoints:* QoL: I pts showed significantly greater improvement in fatigue, physical functioning, positive affect and psychological distress than the Cgroup. Psychological distress: After controlling for no. of blood transfusions, treatment effect on distress did not reach significance. Significant relationship between baseline physical status and psychological distress suggests physical improvement may have contributed to the improvement in psychological distress in I arm.
Wolanskyj et al., 2000 USA NRCT	N=25 Age: I: Median= 60; C: Median=53. % Male: I: 69; C: 67. Diagnosis: Hodgkin's lymphoma or Non-	Inclusion criteria: required bilateral bone marrow biopsy and aspiration; no prior bone marrow biopsy and aspiration; at least 18 years. Exclusion criteria: Pregnant or lactating; unable to complete scales; unwilling to take narcotics	Intervention: n=13. Placebo prior to first bone marrow biopsy and aspiration, 2 mg lorazepam and 2 mg hydromorphone prior to second bone marrow biopsy and aspiration. Control: n=12. Placebo prior to first and second bone marrow biopsy and aspirations.	Measures: *Primary:* Pain (VAS) Anxiety (STAI) Distress (symptom analogue scales) Follow-up: Immediately following bone marrow	• *Primary endpoints:* Pain, anxiety and distress: No difference between groups for any of the outcomes from baseline to follow-up.

Abbreviations: C: Control. D/C: Discharge. HDT: High Dose Therapy. HG-NHL: High Grade-Non-Hodgkins Lymphoma. HL: Hodgkin's Lymphoma. I: Intervention. M: Mean. NHL: Non-Hodgkin's Lymphoma. NRCT: Non-Randomised Controlled Trial. RCT: Randomised Controlled Trial. Pts: Patients. *Measurement scales:* 1RM: One repetition maximum. BFI: Brief Fatigue Inventory. BSI: Brief Symptom Inventory. CES-D: Centres for Epidemiological Studies-Depression. CES-D SF: Centres for Epidemiological Studies-Depression Short Form. ECOG-PS: Eastern Co-Operative Oncology Group-Performance Status. EORTC-QLC-C30: European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire. ESS: Epworth Sleepiness Scale. FACIT-F: Functional Assessment of Chronic Illness Therapy-Fatigue scale. FACT-An: Functional Assessment of Cancer Therapy-Anemia. HADS: Hospital Anxiety and Depression Scale. IES: Impact of Events Scale. ITPA: Interactive Tailored Patient Assessment tool (study specific). MAC: Mental Adjustment to Cancer. MHI: Mental Health Inventory. MOS-SS: Medical Outcome Study Social Support Scale. PAIS-SR: Psychosocial Adjustment to Illness Scale-Self Report. PANAS: Positive Affect and Negative Affect Schedule. PCL-C: Posttraumatic Stress Disorder Checklist-Civilian Version; POMS: Profile of Mood States. PSQI: Pittsburgh Sleep Quality Index. SDS: Symptom Distress Scale. SF12: Short Form Health Survey. STAI: Speilberger State-Trait Anxiety Inventory. STAI SF: Speilberger State-Trait Anxiety Inventory Short Form. STATE: Speilberger State Anxiety Inventory. SFWB: Social and Family Wellbeing. TOI-An: Trial Outcome Index-Anemia. VAS: Visual Analogue Scale. VO_2 max: Maximum volume of oxygen. WAI-S: Working Alliance Inventory-Short Form. ZUF-8: Questionnaire on Patient Satisfaction (German version of Client Satisfaction Questionnaire).

Reference Country Design	Sample N; Age; Gender; Diagnosis	Eligibility Inclusion criteria; Exclusion criteria	Intervention	Outcome measures and time points	Findings
	Hodgkin's lymphoma.	or anxiolytics; history of adverse reactions or allergies to benzodiazepines or narcotics.		biopsy and aspiration and 24 hours later.	
PHYSICAL ACTIVITY INTERVENTIONS					
Coleman et al., 2003 USA RCT	N= 24 Age: Overall: M= 55 % Male: Overall: 58 Diagnosis: Multiple Myeloma	Inclusion criteria: High risk of pathologic fracture; receiving tandem transplantation; ≥40 years of age; not enrolled in other exercise program. Exclusion criteria: None.	Intervention: n=14. Unsupervised home-based exercise program (aerobic and strength resistance training). Pts received stretch bands and a booklet illustrating exercises, and were encouraged to use exercise log book. Control: n=10. Usual care. Encouraged to remain active and walk 20 mins 3 x per week.	Measures: *Primary:* Mood disturbance (POMS), Sleep (Actigraph device and ESS), Lean body weight ("Bod Pod"), Muscle strength (1 RM), Aerobic capacity (Balke protocol) Follow-up: 3 months before first transplantation, at time of transplantation and three months post first transplantation.	• *Primary endpoints:* Mood disturbance: Non-significant improvement for the I compared to C group. Lean body weight: Significant gain in lean body weight for the I compared to the C group over time. Sleep, muscle strength, aerobic capacity: Non-significant improvements for the I compared to C group.
Courneya et al., 2009 Canada RCT	N: 122 Age: I: M=52.8; C: M=53.5 % Male: I: 57%; C: 62%	Inclusion criteria: English speaking; ≥18 years of age; receiving at least 8 weeks of chemotherapy throughout duration of study or no treatment throughout duration of study.	Intervention: n=60. Supervised aerobic exercise sessions 3 x per week for 12 weeks. Initial sessions were 15 minutes, increasing incrementally to 45 minutes by week 9.	Measures: *Primary:* Patient-rated physical functioning (TOI-An) *Secondary:* QoL (FACT-An) Fatigue (FACT-An)	• *Primary endpoint:* Physical functioning: Statistically significant improvement in I group post-intervention (difference not significant at follow up). • *Secondary endpoints:* QoL: Statistically significant

Abbreviations: C: Control. D/C: Discharge. HDT: High Dose Therapy. HG-NHL: High Grade-Non-Hodgkins Lymphoma. HL: Hodgkin's Lymphoma. I: Intervention. M: Mean. NHL: Non-Hodgkin's Lymphoma. NRCT: Non-Randomised Controlled Trial. RCT: Randomised Controlled Trial. Pts: Patients. *Measurement scales:* 1RM: One repetition maximum. BFI: Brief Fatigue Inventory. BSI: Brief Symptom Inventory. CES-D: Centres for Epidemiological Studies-Depression. CES-D SF: Centres for Epidemiological Studies-Depression Short Form. ECOG-PS: Eastern Co-Operative Oncology Group-Performance Status. EORTC-QLC-C30: European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire. ESS: Epworth Sleepiness Scale. FACIT-F: Functional Assessment of Chronic Illness Therapy-Fatigue scale. FACT-An: Functional Assessment of Cancer Therapy-Anemia. HADS: Hospital Anxiety and Depression Scale. IES: Impact of Events Scale. ITPA: Interactive Tailored Patient Assessment tool (study specific). MAC: Mental Adjustment to Cancer. MHI: Mental Health Inventory. MOS-SS: Medical Outcome Study Social Support Scale. PAIS-SR: Psychosocial Adjustment to Illness Scale-Self Report. PANAS: Positive Affect and Negative Affect Schedule. PCL-C: Posttraumatic Stress Disorder Checklist-Civilian Version; POMS: Profile of Mood States. PSQI: Pittsburgh Sleep Quality Index. SDS: Symptom Distress Scale. SF12: Short Form Health Survey. STAI: Speilberger State-Trait Anxiety Inventory. STAI SF: Speilberger State-Trait Anxiety Inventory Short Form. STATE: Speilberger State Anxiety Inventory. SFWB: Social and Family Wellbeing. TOI-An: Trial Outcome Index-Anemia. VAS: Visual Analogue Scale. VO_2 max: Maximum volume of oxygen. WAI-S: Working Alliance Inventory-Short Form. ZUF-8: Questionnaire on Patient Satisfaction (German version of Client Satisfaction Questionnaire).

Reference Country Design	**Sample** N; Age; Gender; Diagnosis	**Eligibility** Inclusion criteria; Exclusion criteria	**Intervention**	**Outcome measures and time points**	**Findings**
	Diagnosis: Lymphoma (Hodgkin's and Non-Hodgkin's)	Exclusion criteria: Uncontrolled hypertension; cardiac illness; lived >80kms from Cancer Institute; not approved for participation by oncologist.	Control: n=62. Pts asked not to increase exercise levels above baseline. Offered 4 weeks supervised exercise after post-intervention assessments.	Happiness (Happiness Scale) Depression (CES-D SF) Anxiety (STAI SF) General health (SF12 single item) Objective measures of fitness (Maximal graded exercise test, lean body mass, % body fat) Follow-up: Post-intervention and at 6 month follow-up.	improvement in I group post-intervention (borderline significance at follow up). Fatigue: Statistically significant improvement in I group post-intervention (not reported at follow up). Happiness: Statistically significant improvement in I group at both follow-up time points. Depression: Statistically significant decrease in I group at both follow-up time points. Anxiety: No significant difference between groups. General health: Statistically significant improvement in I group post-intervention (not reported at follow up). Fitness: Statistically significant improvement in I group post-intervention (not assessed at follow up).
PSYCHOTHERAPEUTIC INTERVENTIONS					
Burns et al., 2008 USA CCT	N= 49 Age: I: M=52.5±15.4; C: M=55.5±15.9	Inclusion Criteria: ≥18 years of age; fluent in English; admitted to haematology-oncology unit for treatment.	Intervention: n=25. Standard care of HEPA filtered room with restricted visitor access; chemotherapy; antibiotics and clinical support as required, plus music imagery sessions (45 min duration) within 3 days of admission then twice weekly	Measures: *Primary:* Affect (PANAS), Fatigue (FACIT-F), Anxiety (STATE)	• *Primary endpoints:* Affect, fatigue, anxiety: No indication that I was significantly more beneficial than C. Pts in I group with low negative affect at baseline had lower anxiety at discharge compared to C group.

Abbreviations: C: Control. D/C: Discharge. HDT: High Dose Therapy. HG-NHL: High Grade-Non-Hodgkins Lymphoma. HL: Hodgkin's Lymphoma. I: Intervention. M: Mean. NHL: Non-Hodgkin's Lymphoma. NRCT: Non-Randomised Controlled Trial. RCT: Randomised Controlled Trial. Pts: Patients. *Measurement scales:* 1RM: One repetition maximum. BFI: Brief Fatigue Inventory. BSI: Brief Symptom Inventory. CES-D: Centres for Epidemiological Studies-Depression. CES-D SF: Centres for Epidemiological Studies-Depression Short Form. ECOG-PS: Eastern Co-Operative Oncology Group-Performance Status. EORTC-QLC-C30: European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire. ESS: Epworth Sleepiness Scale. FACIT-F: Functional Assessment of Chronic Illness Therapy-Fatigue scale. FACT-An: Functional Assessment of Cancer Therapy-Anemia. HADS: Hospital Anxiety and Depression Scale. IES: Impact of Events Scale. ITPA: Interactive Tailored Patient Assessment tool (study specific). MAC: Mental Adjustment to Cancer. MHI: Mental Health Inventory. MOS-SS: Medical Outcome Study Social Support Scale. PAIS-SR: Psychosocial Adjustment to Illness Scale-Self Report. PANAS: Positive Affect and Negative Affect Schedule. PCL-C: Posttraumatic Stress Disorder Checklist-Civilian Version; POMS: Profile of Mood States. PSQI: Pittsburgh Sleep Quality Index. SDS: Symptom Distress Scale. SF12: Short Form Health Survey. STAI: Speilberger State-Trait Anxiety Inventory. STAI SF: Speilberger State-Trait Anxiety Inventory Short Form. STATE: Speilberger State Anxiety Inventory. SFWB: Social and Family Wellbeing. TOI-An: Trial Outcome Index-Anemia. VAS: Visual Analogue Scale. VO_2 max: Maximum volume of oxygen. WAI-S: Working Alliance Inventory-Short Form. ZUF-8: Questionnaire on Patient Satisfaction (German version of Client Satisfaction Questionnaire).

Reference Country Design	**Sample** N; Age; Gender; Diagnosis	**Eligibility** Inclusion criteria; Exclusion criteria	**Intervention**	**Outcome measures and time points**	**Findings**
	%Male: Overall: 39% Diagnosis: Acute leukemia or high-grade non-Hodgkin's lymphoma	Exclusion Criteria: Cognitively unable to participate in the intervention or answer questionnaire.	until discharge for up to 8 sessions. Pts provided with equipment to continue music imagery alone. Control: n=14. Standard care only.	Follow-Up: Weekly, throughout the intervention period.	
Danhauer et al., 2012 USA CCT	N: 59 Age: I: M=50.2±14.1; C: M=51.6±13.8 % Male: I: 34%; C: 47% Diagnosis: Any hematological malignancy	Inclusion criteria: ≥18 years of age; scheduled to bone marrow biopsy; ability to read and write English. Exclusion criteria: None.	Intervention: n=29. Music during biopsy (choice of 8 CD's). Control: n=30. Usual Care	Measures: *Primary:* Anxiety (STAI), Pain (VAS), Patient satisfaction (10 items) Follow-Up: Post biopsy.	• *Primary endpoints:* Anxiety, pain, satisfaction: No significant differences in outcomes between groups at post-biopsy.
David 2013 Germany RCT	N: 186 Age: I:M= 47.2±11.2; C: M=47.5±13.1 % Male: I: 44%; C: 35%	Inclusion criteria: Blood cancer diagnosis; ≥18 years of age; internet access. Exclusion criteria: None.	Intervention: n=105. 4 weeks access to internet website "Psychological Self Help with Leukaemia". Module content included: i) Stress and behavioural assessment ii) Cognitive behavioural techniques iii) Coping techniques iv) Expressive writing v) email support with psychologist.	Measures: *Primary:* Mental Adjustment (MAC), Psychological Distress (BSI), Client satisfaction (ZUF-8) Follow-Up:	• *Primary endpoints:* Mental adjustment: I group showed some significant improvements compared to C group (increased fighting spirit, lower fatalism) post-intervention. Psychological distress: No significant changes between groups post-intervention.

Abbreviations: C: Control. D/C: Discharge. HDT: High Dose Therapy. HG-NHL: High Grade-Non-Hodgkins Lymphoma. HL: Hodgkin's Lymphoma. I: Intervention. M: Mean. NHL: Non-Hodgkin's Lymphoma. NRCT: Non-Randomised Controlled Trial. RCT: Randomised Controlled Trial. Pts: Patients. *Measurement scales:* 1RM: One repetition maximum. BFI: Brief Fatigue Inventory. BSI: Brief Symptom Inventory. CES-D: Centres for Epidemiological Studies-Depression. CES-D SF: Centres for Epidemiological Studies-Depression Short Form. ECOG-PS: Eastern Co-Operative Oncology Group-Performance Status. EORTC-QLC-C30: European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire. ESS: Epworth Sleepiness Scale. FACIT-F: Functional Assessment of Chronic Illness Therapy-Fatigue scale. FACT-An: Functional Assessment of Cancer Therapy-Anemia. HADS: Hospital Anxiety and Depression Scale. IES: Impact of Events Scale. ITPA: Interactive Tailored Patient Assessment tool (study specific). MAC: Mental Adjustment to Cancer. MHI: Mental Health Inventory. MOS-SS: Medical Outcome Study Social Support Scale. PAIS-SR: Psychosocial Adjustment to Illness Scale-Self Report. PANAS: Positive Affect and Negative Affect Schedule. PCL-C: Posttraumatic Stress Disorder Checklist-Civilian Version; POMS: Profile of Mood States. PSQI: Pittsburgh Sleep Quality Index. SDS: Symptom Distress Scale. SF12: Short Form Health Survey. STAI: Speilberger State-Trait Anxiety Inventory. STAI SF: Speilberger State-Trait Anxiety Inventory Short Form. STATE: Speilberger State Anxiety Inventory. SFWB: Social and Family Wellbeing. TOI-An: Trial Outcome Index-Anemia. VAS: Visual Analogue Scale. VO_2 max: Maximum volume of oxygen. WAI-S: Working Alliance Inventory-Short Form. ZUF-8: Questionnaire on Patient Satisfaction (German version of Client Satisfaction Questionnaire).

Reference Country Design	Sample N; Age; Gender; Diagnosis	Eligibility Inclusion criteria; Exclusion criteria	Intervention	Outcome measures and time points	Findings
	Diagnosis: Chronic myeloid leukemia; acute myeloid leukemia; myelodysplastic syndrome; acute lymphoblastic leukemia.		Control: n=81. Enrolled to waiting list.	Baseline (registration) and at 4 weeks	
SYSTEMS BASED INTERVENTIONS					
Ruland et al., 2010 Norway RCT	N=145 Age: I: M=50±15; C: M=49±15. % Male: I: 60; C: 64. Diagnosis: Leukemia (n=18); Lymphoma (n=111); myelomatosis (n=6).	Inclusion criteria: Starting treatment for newly diagnosed Acute Myeloid Leukaemia, Acute non-lymphocytic leukemia, Multiple Myeloma, Hodgkin's lymphoma or Non-Hodgkin's lymphoma; starting treatment for a recurrence or with allogenic or autologous stem cell support for the same diseases; at least 18 years; no radiation of the brain. Exclusion criteria: None.	Intervention: n=75. Computer-assisted, interactive tailored patient assessment tool (ITPA) that allowed the pt to communicate their symptoms, problems and concerns prior to inpatient and outpatient visits. The tool enabled pts to rank their symptoms to allow for prioritisation of their concerns. Upon completion, a summary of their results was immediately communicated to clinicians to support them in their communications with the pt.	Measures: *Primary:* No. patient symptoms and problems addressed by staff (patient record review), Symptom distress (ITPA), Patient need for symptom management (ITPA) Follow-up: Inpatient readmission: assessment completed again prior to treatment, and once per week for length of stay;	• *Primary endpoints:* Symptoms and problems: Significantly more symptoms and problems were addressed for the I compared to C group. Symptom distress: Significant decreases in symptom distress for 10 problem categories in the I group, compared to 2 problem categories in the C group. Need for symptom management: Significant downward trend in the need for symptom management support for some need categories in the I group compared to a significant increase in the C group.

Abbreviations: C: Control. D/C: Discharge. HDT: High Dose Therapy. HG-NHL: High Grade-Non-Hodgkins Lymphoma. HL: Hodgkin's Lymphoma. I: Intervention. M: Mean. NHL: Non-Hodgkin's Lymphoma. NRCT: Non-Randomised Controlled Trial. RCT: Randomised Controlled Trial. Pts: Patients. *Measurement scales:* 1RM: One repetition maximum. BFI: Brief Fatigue Inventory. BSI: Brief Symptom Inventory. CES-D: Centres for Epidemiological Studies-Depression. CES-D SF: Centres for Epidemiological Studies-Depression Short Form. ECOG-PS: Eastern Co-Operative Oncology Group-Performance Status. EORTC-QLC-C30: European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire. ESS: Epworth Sleepiness Scale. FACIT-F: Functional Assessment of Chronic Illness Therapy-Fatigue scale. FACT-An: Functional Assessment of Cancer Therapy-Anemia. HADS: Hospital Anxiety and Depression Scale. IES: Impact of Events Scale. ITPA: Interactive Tailored Patient Assessment tool (study specific). MAC: Mental Adjustment to Cancer. MHI: Mental Health Inventory. MOS-SS: Medical Outcome Study Social Support Scale. PAIS-SR: Psychosocial Adjustment to Illness Scale-Self Report. PANAS: Positive Affect and Negative Affect Schedule. PCL-C: Posttraumatic Stress Disorder Checklist-Civilian Version; POMS: Profile of Mood States. PSQI: Pittsburgh Sleep Quality Index. SDS: Symptom Distress Scale. SF12: Short Form Health Survey. STAI: Speilberger State-Trait Anxiety Inventory. STAI SF: Speilberger State-Trait Anxiety Inventory Short Form. STATE: Speilberger State Anxiety Inventory. SFWB: Social and Family Wellbeing. TOI-An: Trial Outcome Index-Anemia. VAS: Visual Analogue Scale. VO_2 max: Maximum volume of oxygen. WAI-S: Working Alliance Inventory-Short Form. ZUF-8: Questionnaire on Patient Satisfaction (German version of Client Satisfaction Questionnaire).

Reference Country Design	**Sample** N; Age; Gender; Diagnosis	**Eligibility** Inclusion criteria; Exclusion criteria	**Intervention**	**Outcome measures and time points**	**Findings**
			Control: n=70. Pts used the tool, however a summary of their results was not communicated to clinicians.	Outpatient visits: completed prior to consultation for up to four visits.	
MULTICOMPONENT INTERVENTIONS					
Cohen et al., 2004 USA RCT	N=38; I: n=19; C: n=19 Age: Overall: M=51 % Male: Overall: 68% Diagnosis: Lymphoma	Inclusion Criteria: receiving chemotherapy regimen; ≥18 years of age; fluent in English. Exclusion Criteria: Major psychotic illness.	Intervention: n=19. Seven weekly Tibetan Yoga sessions (controlled breathing, mindfulness, yoga postures). Pts given printed materials and audiotape to assist daily self-delivery of techniques. Control: n=19. Assigned to a wait list, contacted for follow-up assessments. Pts offered Tibetan Yoga sessions after the 3 month follow-up assessment was completed.	Measures: *Primary:* Fatigue (BFI) Sleep disturbance (PSQI) Distress (IES), Anxiety (STATE), Depression (CES-D) Follow-Up: 1 week, 1 month and 3 months.	• *Primary endpoints:* Fatigue: No significant difference between groups for fatigue at follow-up (averaged across all time points). Sleep: Significantly better overall sleep quality in I group than C group. Distress, anxiety and depression*:* No significant differences between the I and C groups.
Jarden et al., 2009 Denmark RCT	N: 42 Age: I: M=40.9±13.3; C: M=37.4±11.1 % Male: I: 61.9% C: 61.9%	Inclusion criteria: 18-65 years; scheduled for myoblastive allogeneic- Hematopoietic Stem Cell Transplant. Exclusion criteria: Prior Hematopoietic Stem Cell Transplant; recent cardiovascular/ pulmonary disease; abnormal electrocardiogram; psychiatric disorder; motor, musculoskeletal or	Intervention: n= 21. Usual care and structured, supervised adjuvant multimodal program of physical exercise, progressive relaxation and psycho-education. The aim was to encourage a sense of personal control, enhance motivation and self-efficacy. Delivered in hospital ward 5 days/ week for 1hr±10mins, beginning on admission and ceasing on the day of discharge.	Measures: *Primary:* Physical capacity (VO_2 max) *Secondary:* Muscle strength (1RM), Functional performance (2 min stair test), QoL (EORTC-QLQ-C30; FACT-An), Fatigue (FACT-An),	• *Primary endpoints:* Physical capacity: Significantly improved in the I compared to C group post-intervention. • *Secondary endpoints:* Muscle strength and functional performance: were also significantly improved in the I compared to C group. QoL, Fatigue, and Depression and Anxiety: No significant between-

Abbreviations: C: Control. D/C: Discharge. HDT: High Dose Therapy. HG-NHL: High Grade-Non-Hodgkins Lymphoma. HL: Hodgkin's Lymphoma. I: Intervention. M: Mean. NHL: Non-Hodgkin's Lymphoma. NRCT: Non-Randomised Controlled Trial. RCT: Randomised Controlled Trial. Pts: Patients. *Measurement scales:* 1RM: One repetition maximum. BFI: Brief Fatigue Inventory. BSI: Brief Symptom Inventory. CES-D: Centres for Epidemiological Studies-Depression. CES-D SF: Centres for Epidemiological Studies-Depression Short Form. ECOG-PS: Eastern Co-Operative Oncology Group-Performance Status. EORTC-QLC-C30: European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire. ESS: Epworth Sleepiness Scale. FACIT-F: Functional Assessment of Chronic Illness Therapy-Fatigue scale. FACT-An: Functional Assessment of Cancer Therapy-Anemia. HADS: Hospital Anxiety and Depression Scale. IES: Impact of Events Scale. ITPA: Interactive Tailored Patient Assessment tool (study specific). MAC: Mental Adjustment to Cancer. MHI: Mental Health Inventory. MOS-SS: Medical Outcome Study Social Support Scale. PAIS-SR: Psychosocial Adjustment to Illness Scale-Self Report. PANAS: Positive Affect and Negative Affect Schedule. PCL-C: Posttraumatic Stress Disorder Checklist-Civilian Version; POMS: Profile of Mood States. PSQI: Pittsburgh Sleep Quality Index. SDS: Symptom Distress Scale. SF12: Short Form Health Survey. STAI: Speilberger State-Trait Anxiety Inventory. STAI SF: Speilberger State-Trait Anxiety Inventory Short Form. STATE: Speilberger State Anxiety Inventory. SFWB: Social and Family Wellbeing. TOI-An: Trial Outcome Index-Anemia. VAS: Visual Analogue Scale. VO_2 max: Maximum volume of oxygen. WAI-S: Working Alliance Inventory-Short Form. ZUF-8: Questionnaire on Patient Satisfaction (German version of Client Satisfaction Questionnaire).

Reference Country Design	**Sample** N; Age; Gender; Diagnosis	**Eligibility** Inclusion criteria; Exclusion criteria	**Intervention**	**Outcome measures and time points**	**Findings**
	Diagnosis: Chronic Myeloid Leukemia; n=9, Acute Myeloid Leukemia; n=16, Acute non-lymphocytic leukemia; n=8, Aplastic Anemia; n=4, Myelodysplastic Syndrome; n=2, Waldenstrom macroglobulinemia; n=1, Paroxysmal nocturnal hemoglobinuria; n=1, Myelofibrosis; n=1.	neurological dysfunction requiring walking aids; bony metastases; abnormal blood test results.	Control: n=21. Usual care including standard of care of physical activity from admission to discharge (up to 1.5hrs weekly).	Psychological wellbeing (HADS) Follow-Up: Post intervention, 3 and 6 months.	group differences were found at the three time points.

Abbreviations: C: Control. D/C: Discharge. HDT: High Dose Therapy. HG-NHL: High Grade-Non-Hodgkins Lymphoma. HL: Hodgkin's Lymphoma. I: Intervention. M: Mean. NHL: Non-Hodgkin's Lymphoma. NRCT: Non-Randomised Controlled Trial. RCT: Randomised Controlled Trial. Pts: Patients. *Measurement scales:* 1RM: One repetition maximum. BFI: Brief Fatigue Inventory. BSI: Brief Symptom Inventory. CES-D: Centres for Epidemiological Studies-Depression. CES-D SF: Centres for Epidemiological Studies-Depression Short Form. ECOG-PS: Eastern Co-Operative Oncology Group-Performance Status. EORTC-QLC-C30: European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire. ESS: Epworth Sleepiness Scale. FACIT-F: Functional Assessment of Chronic Illness Therapy-Fatigue scale. FACT-An: Functional Assessment of Cancer Therapy-Anemia. HADS: Hospital Anxiety and Depression Scale. IES: Impact of Events Scale. ITPA: Interactive Tailored Patient Assessment tool (study specific). MAC: Mental Adjustment to Cancer. MHI: Mental Health Inventory. MOS-SS: Medical Outcome Study Social Support Scale. PAIS-SR: Psychosocial Adjustment to Illness Scale-Self Report. PANAS: Positive Affect and Negative Affect Schedule. PCL-C: Posttraumatic Stress Disorder Checklist-Civilian Version; POMS: Profile of Mood States. PSQI: Pittsburgh Sleep Quality Index. SDS: Symptom Distress Scale. SF12: Short Form Health Survey. STAI: Speilberger State-Trait Anxiety Inventory. STAI SF: Speilberger State-Trait Anxiety Inventory Short Form. STATE: Speilberger State Anxiety Inventory. SFWB: Social and Family Wellbeing. TOI-An: Trial Outcome Index-Anemia. VAS: Visual Analogue Scale. VO_2 max: Maximum volume of oxygen. WAI-S: Working Alliance Inventory-Short Form. ZUF-8: Questionnaire on Patient Satisfaction (German version of Client Satisfaction Questionnaire).

Table 2. EPOC Methodological quality of interventions.

Reference	Type	Allocation sequence adequately generated	Concealment of allocation	Baseline outcome measurements similar	Baseline characteristics similar	Incomplete outcome data adequately addressed	Knowledge of allocated interventions prevented?	Protection against contamination	Selective outcome reporting	Free from other risk of bias
Kornblith 2002	CCT	High risk	Unclear risk	High risk	Low risk	Low risk	Unclear risk	Unclear risk	Low risk	Low risk
Wolanskyj 2000	CCT	High risk	Unclear risk	Unclear risk	Unclear risk	Low risk	Low risk	Low risk	Low risk	Low risk
Coleman 2003	CCT	High risk	Low risk	Unclear risk	Unclear risk	Low risk	Unclear risk	Low risk	Low risk	Low risk
Courneya 2009	RCT	Low risk	Low risk	Low risk	Low risk	Low risk	High risk	Low risk	Low risk	High risk
Burns 2008	CCT	High risk	Unclear risk	Low risk	Unclear risk	Unclear risk	Unclear risk	Low risk	Low risk	Low risk
David 2013	RCT	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk	Low risk	Low risk	Low risk
Danhauer 2010	CCT	High risk	Unclear risk	Low risk	Low risk	Low risk	Unclear risk	Low risk	Low risk	Low risk
Ruland 2010	RCT	Low risk	Low risk	Unclear risk	Low risk	Low risk	Low risk	High risk	Low risk	Low risk
Cohen 2004	RCT	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk	Low risk	Low risk	Low risk

Jarden 2009	RCT	Low risk	Low risk	Unclear risk	Low risk	Low risk	Unclear risk	Low risk	Low risk	Low risk

Additional File 1. OVID Medline, Embase, PsychInfo and Cochrane database search strategies.

Database: Ovid MEDLINE(R) and Ovid OLDMEDLINE(R). 1946 to December 2014.

Search	Query
#1	exp Multiple myeloma/
#2	(multiple myeloma* or myeloma*).mp.
#3	exp Leukemia/
#4	exp Lymphoma/or exp Lymphoma, Non-Hodgkin/
#5	(hodgkin* lymphoma* or nonhodgkin* lymphoma* or non-hodgkin* lymphoma*
#6	exp Hematologic neoplasms/
#7	(hematologic* neoplasm* or haematologic* neoplasm*).mp.
#8	(hematologic* cancer* or haematologic* cancer*).mp.
#9	(hematologic* malignanc* or haematologic* malignanc*).mp.
#10	exp Myeloproliferative Disorders/
#11	(myeloproliferative disease* or myeloproliferative disorder*).tw.
#12	Or/1-11
#13	stress disorders, traumatic/ or stress disorders, post-traumatic/ or stress disorders, traumatic, acute/
#14	exp Stress, Psychological/
#15	(psychological stress or psychological distress).tw.
#16	exp Depression/ or depressive disorder/ or dysthymic disorder/
#17	Mental Health/ or Mental processes/ or mental health.mp.
#18	Mental disorders/ or adjustment disorders/ or anxiety disorders / or mood disorders.mp.
#19	Affective symptoms/ or affective symptom*.mp.
#20	exp Anxiety/ or anxiety disorders/ or anxiety.tw.
#21	(emotional wellbeing or emotional well-being or psychological wellbeing or psychological well-being).mp.
#22	(psychology or psychosocial or psychological).tw.
#23	Behavioral symptoms/
#24	Adaption, Psychological/
#25	exp Emotions/

#26	Social adjustment/ or social support/ or social isolation/
#27	(Social adjustment or social support or social isolation).tw.
#28	(social wellbeing or social well-being).tw.
#29	Or/13-28
#30	12 and 29
#31	30 not exp child/
#32	Limit 31 to (english language and humans)
#33	Limit 32 to (case reports or clinical conference or comment or congresses or editorial or lectures or letter or patient education handout)
#34	32 not 33

Database: Embase. Searched 1980 to December 2014.

Search	**Query**
#1	exp multiple myeloma/
#2	(multiple myeloma* or myeloma*).mp.
#3	exp leukemia/
#4	exp lymphoma/
#5	exp hematologic malignancy/
#6	(hematologic* neoplasm* or haematologic* neoplasm*).mp.
#7	(hematologic* cancer* or haematologic* cancer*).mp.
#8	(hematologic malignanc* or haematologic*malignanc*).mp.
#9	(hodgkin* lymphoma* or nonhodgkin* lymphoma* or non-hodgkin* lymphoma*).mp.
#10	exp myeloproliferative disorder/
#11	(myeloproliferative disease* or myeloproliferative disorder*).mp.
#12	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
#13	posttraumatic stress disorder/ or social stress.tw.
#14	emotional stress/
#15	coping behavior/
#16	mental health/
#17	adaptive behavior/ or exp mood disorder/
#18	exp emotion/ or exp emotion disorder/

#19	wellbeing/
#20	psychological well being/
#21	psychological aspect/ or psychosocial care/
#22	exp anxiety disorder
#23	social adaption/ or social isolation/ or social support/
#24	(social wellbeing or social well-being).tw.
#25	13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24
#26	12 and 25
#27	26 not (*exp child/ or childhood.hw. or child.hw. or childhood cancer/)
#28	Limit 27 to (abstracts and human and english language)
#29	limit 28 to (book or book series or conference abstract or conference paper or conference proceeding or "conference review" or editorial or letter or note
#30	28 not 29
#31	30 not case report.af.

Database: PsycINFO. 1967 to December 2014.

Search	**Query**
#1	exp Blood/
#2	exp Neoplasms/
#3	1 and 2
#4	exp “Blood and Lymphatic Disorders”/
#5	exp Leukemias/
#6	(multiple myeloma* or myeloma*).mp.
#7	lymphoma*.tw.
#8	(hematologic* neoplasm* or haematologic* neoplasm*).mp.
#9	(hematologic* cancer* or haematologic* cancer*).mp.
#10	(hematologic* malignanc* or haematologic* malignanc*).mp.
#11	(hodgkin* lymphoma* or nonhodgkin* lymphoma* or non-hodgkin* lymphoma*
#12	(myeloproliferative disease* or myeloproliferative disorder*).mp.
#13	2 and 4
#14	3 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13

#15	exp stress/ or exp psychological stress/ or exp stress reactions/
#16	(psychological stress or psychological distress*).tw.
#17	exp acute stress disorder/ or exp posttraumatic stress disorder/
#18	exp emotional states/
#19	(emotional wellbeing or emotional well-being or psychological wellbeing or psychological well-being).mp.
#20	exp affective disorders/
#21	affective symptom*.mp.
#22	exp Major Depression/ or exp "Depression (Emotion)"/
#23	exp Dysthymic Disorder/
#24	exp psychosocial factors/
#25	(psychology or psychosocial or psychological).tw.
#26	exp mental disorders/ or exp mental health/
#27	exp anxiety disorders/ or exp anxiety/ or anxiety.tw.
#28	(social adjustment or social support or social isolation or social well-being or social wellbeing).tw.
#29	exp adjustment disorders/ or exp adjustment/ or exp emotional adjustment/ or social adjustment/ or social support/ or social isolation/
#30	exp well being/ or exp life satisfaction/
#31	exp behavior/ or exp adaptive behavior/ or exp behavior disorders/ or exp behavior problems/
#32	15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31
#33	14 and 32
#34	Limit 33 to (human and english language)
#35	Limit 34 to adulthood <18+ years>
#36	35 not case report*.af.
#37	36 not child*.sh.

Database: The Cochrane Library. Searched from inception to December 2014

Search	**Query**
#1	MeSH descriptor: [Hematologic Neoplasms] explode all trees

#2	hematologic* neoplasm* or haematologic neoplasm*:ti,ab,kw (Word variations have been searched)
#3	hematologic* cancer* or haematologic* cancer*:ti,ab,kw (Word variations have been searched)
#4	hematologic malignancy or haematologic malignancy:ti,ab,kw (Word variations have been searched)
#5	lymphoma:ti,ab,kw (Word variations have been searched)
#6	Leukemia:ti,ab,kw (Word variations have been searched)
#7	multiple myeloma:ti,ab,kw (Word variations have been searched)
#8	MeSH descriptor: [Myeloproliferative Disorders] explode all trees
#9	#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8
#10	MeSH descriptor: [Mental Disorders] explode all trees
#11	stress or depress* or dysthymic or anxiety or affective symptom* or mood:ti,ab,kw (Word variations have been searched)
#12	MeSH descriptor: [Stress, Psychological] explode all trees
#13	psychologic* stress or psychological distress:ti,ab,kw (Word variations have been searched)
#14	MeSH descriptor: [Social Adjustment] explode all trees
#15	MeSH descriptor: [Social Support] explode all trees
#16	MeSH descriptor: [Social Isolation] explode all trees
#17	MeSH descriptor: [Adaptation, Psychological] explode all trees
#18	social isolation or social adjustment or social support:ti,ab,kw (Word variations have been searched)
#19	social wellbeing or social well-being:ti,ab,kw
#20	MeSH descriptor: [Emotions] explode all trees
#21	emotional wellbeing or emotional well-being or psychological wellbeing or psychological well-being:ti,ab,kw
#22	MeSH descriptor: [Anxiety] explode all trees
#23	anxiety:ti,ab,kw (Word variations have been searched)
#24	MeSH descriptor: [Behavioral Symptoms] explode all trees
#25	psychology or psychosocial or psychological:ti,ab,kw (Word variations have been searched)
#26	MeSH descriptor: [Adjustment Disorders] explode all trees

#27	#10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26
#28	#9 and #27

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