Table 1: Controlled clinical trials of progressive muscle relaxation for cancer

Source: Ava Lorenc, Helen Cooke, CAM-Cancer Consortium. Progressive Muscle Relaxation [online document], March 2019.

Outcome	First author Year (ref no)	Study design	Participants Diagnosis (number)	Interventions/controls	Main outcome measures	Main results	Comments
Anxiety and depression	Holland, 1991 (11)	RCT	Patients with a variety of cancers (n=147)	1) PMR (face-to-face and audiorecording) 2) Alprazolam	1) Covi Anxiety scale 2) Raskin Depression scale 3) Affects Balance scale 4) Symptoms Checklist-90 (SCL-90).	Both groups reported a decrease from baseline levels in anxiety and symptoms of depression, although patients receiving the drug showed a slightly more rapid decrease in anxiety and a greater reduction in depressive symptoms	No non-treatment control arm included. Sample size not powered and quite high dropout.
	Cheung, 2003 (12)	RCT	Patients with colorectal cancer (n=59)	1) PMR (face-to-face and audiorecording) and standard care 2) Routine care only	1) State-trait anxiety scale (Chinese version) 2) QOL-Colostomy (Chinese version) 3)WHOQOL-BREF (Hong Kong Chinese version)	The use of PMR significantly decreased state anxiety and improved generic quality of life in the experimental group ($p<0.05$), especially in the domains of physical health, psychological health, social concerns and environment. No improvement in disease-specific quality of life.	Sample size was powered and good details of randomisation. Baseline assessment was not performed prior to surgery, as it was uncertain whether patients would undergo stoma surgery or a bowel resection.
	Lee et al. 2012 (15)	Pilot RCT	Patients with gynaecological cancer undergoing chemotherapy (n=40)	1) Monochord sounds (MC) (music therapy) 2) PMR	1) Spielberger's State Anxiety Inventory (SAI) 2) Questionnaire assessing physical and psychological wellbeing 3) EEG	Both groups showed significant improvement in both physical and psychological wellbeing ($p<0.05$) and state anxiety ($p=0.008$). EEG results for both MC and PMR were associated with an increase in positive theta band activity and midfrontal beta band activity.	No non-treatment control arm included. It is unclear if all outcome measures are validated scales.
Anxiety, depression, stress	Isa et al. (2013) (14) (note this is based on the same study as ref 13)	Non-randomised quasi-experimental	Men with prostate cancer (n=138)	1) PMR 2) Matched comparison group (no intervention although they did receive general information about prostate cancer and quality of life issues))	1)Depression Anxiety Stress scale -21) (DASS-21)	Significant improvements in anxiety and stress were reported in both groups ($p<0.01$). No reported improvement in depression scores ($p=0.956$) in either group.	Lack of randomization, principal investigator also conducted PMR. Questionnaires were self-administered.

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Anxiety, depression, stress	Goerling et al. (2014) (18)	Prospective randomised	Women with gynaecological cancer (n=45)	1) Single psycho-oncological session 2) Single session PMR	1) Hospital Anxiety Depression Scale (German version) 2)Perceived stress questionnaire 3) Physiological stress parameters measured by a portable Nexus-10 device	Both types of intervention may reduce anxiety. A single psycho-oncological session might be slightly more effective in treating depression (p=0.078). A single PMR session has a slightly stronger effect on physiological stress parameters (p=0.031)	Small sample size reduces external validity. Both interventions only consisted of a short single session.
Brain glucose metabolism	Pifarré et al 2015 (17)	RCT	Oncological patients undergoing a stressful diagnostic medical intervention (n=84)	1) PMR (face-to-face) and usual care 2) Diazepam and usual care 3) Control group (usual care only)	1) Brain glucose metabolism (measured by positron emission tomography)	Compared to reference control subjects, the PMR and diazepam groups showed a statistically significant, bilateral and generalized cortical hypometabolism (7–8% reduction in glucose utilization). No significant differences between PMR and diazepam groups.	No information on randomisation or drop-outs/missing data. Little information on recruitment.
Stress, blood pressure and heart rate	Kim et al (2016) (19)	Non-randomised quasi-experimental	Colorectal cancer patients undergoing laparoscopic surgery (n=46)	1) PMR (face-to-face, 10min sessions twice a day for 5 days) and treatment as usual (post-operative nursing care) 2) Treatment as usual (post-operative nursing care)	1) Cortisol levels 2) Stress Arousal Checklist (SACL) 3) Blood pressure 4) Heart rate	Cortisol levels were significantly lower in PMR group on the first day after surgery (p=0.036) but not on the third or fifth days. Total SACL score was not significantly different (although three of the 30 items were). Systolic and diastolic blood pressure were significantly lower at 3 (p=0.043; p=0.003) and 5 days postoperatively (p=0.010; p<0.001). Heart rate was significantly lower at 1 day (p=0.002) and 3 days (p=0.010) postoperatively.	Powered sample size. Study was not randomised or blinded. No information on missing data.

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Quality of life	Koplin et al (2016) (16)	RCT	Colorectal carcinoma patients undergoing colonic resection (n=60)	1) Guided imagery (audiotape) 2) PMR (audiotape) 3) Control group (no intervention)	1) Quality of life measured by EORTC-QLQ-C30 2) Gastrointestinal Quality of Life Index (GIQLI) 3) Affect measured by PANAS	Neither interventions affected short-term quality of life following surgery. Higher preoperative affect was associated with lower postoperative (30-day) quality of life.	Sample size was powered. Risk of bias as randomisation and blinding not described and no details of missing data. Interventions were audiotapes only ("*patients were supposed to hear the text three times daily*") and adherence was not assessed.
Health related quality of life	Isa et al. (2013) (13) (note this is based on the same study as ref 14)	Non-randomised quasi-experimental	Men with prostate cancer (n=138)	1) PMR 2) Matched comparison group (no intervention)	1) SF 36	Significant between group difference for mental component summary (MCS) (p=0.0327) and overall HRQOL (p=0.042). No significant between group difference for physical component summary (PCS) (p=0.965).	Lack of randomization, principle investigator also conducted PMR. Questionnaires were self-administered.
Self-efficacy	Noruzi zamenjani et al (2019) (20)	RCT	Cancer patients (n=80)	1) PMR (face-to-face) 2) Control group (no intervention)	1) Strategies Used by People to Promote Health (SUPPH) questionnaire	Statistically significant difference between the means of self-efficacy (p=0.001).	Sample size was powered and there were no drop-outs. Randomisation described. Researcher-delivered PMR.

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Sleep quality and insomnia	Simeit, 1991 (9)	RCT	Patients with a variety of different cancers (n=229)	1) Multi-modal psychological sleep management programme 2) Standard rehabilitation programme (including counselling, relaxation, psychological support etc)	1) Questionnaire derived from the Pittsburgh Sleep Quality Index (PSQI) 2) EORTC-QLQ-30	The intervention group participants benefited with moderate or large-scale effects on sleep latency ($p<0.001$), sleep duration ($p<0.001$), sleep efficiency ($p<0.001$), sleep quality ($p<0.001$), sleep medication ($p<0.05$) and daytime dysfunction ($p<0.05$).	PMR (n=80) and autogenic training (n=71) were equally effective in enhancing various sleep parameters and reducing the need for sleep medication. No non-treatment control group included.
	Cannici, 1983 (10)	RCT	Patients with a variety of different cancers (n=30)	1) PMR 2) Routine care	1) Daily sleep questionnaire 2) State-Trait Anxiety Inventory	The mean sleep onset latency was reduced from 124 to 29 minutes in the intervention group, but only from 116 to 104 minutes in the group receiving routine care.	Small sample size
Nausea and vomiting	Cotanch, 1987 (22)	RCT	People with different types of cancer (n=60)	1) PMR 2) Control group where participants listened to music 3) No intervention control	1) Duke Descriptive Scale (DDS) 2) State-trait anxiety inventory	A statistically significant difference was obtained for the dependent variables of vomiting ($p=0.03$), trait anxiety ($p=0.05$). Difference obtained for the variables of nausea and state anxiety were not significant at the 0.05 level.	Minimal information given about randomisation method.
	Molassiotis et al 2002 (21)	RCT	Breast cancer patients on Adriamycin with cyclo-phosphamide chemotherapy (n=71)	1) PMR (face-to-face, 6 daily sessions plus audiotapes for home practice) and treatment as usual (standard antiemetic protocol) 2) Treatment as usual (standard antiemetic protocol)	1) Profile of Mood States (POMS) 2) State-Trait Anxiety Inventory (STAI) 3) Morrow Assessment of Nausea and Vomiting Scale (MANE)	PMR group had significantly shorter duration of nausea and vomiting compared to control ($P<0.05$), and significantly less severe overall mood disturbance ($P<0.05$). Frequency of nausea and vomiting showed a trend but was not significant ($P=0.07$ and $P=0.08$ respectively) Intensity of nausea nor vomiting was not significantly different.	Randomisation is detailed. Powered sample size. Very little missing data. PMR was therapist-delivered

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Pain	Kwekkeboom 2008 (4)	Controlled pilot (crossover design)	Hospitalized patients with a variety of different cancers (n=40)	Each participant had two trials of PMR, two trials of analgesic imagery and two trials of a control condition	1) Imagery Ability Scale 2) Relaxation Ability Scale 3) Outcome Expectancy Scale 4) Edmonton Symptom Assessment 5) Pain intensity scale (not specified) 6) The Control Sub-scale from the Survey of Pain Attitudes	In comparing means between treatment and control conditions, both PMR and analgesic imagery produced greater improvements in pain intensity, pain-related distress, and perceived control over pain than the control condition. However, individual responder analysis revealed that only half of the participants achieved a clinically meaningful improvement in pain with each intervention.	Small sample size, no non-treatment control group included.
Pain and fatigue	Pathak et al. (2013) (24)	Quasi experimental randomised controlled trial	People with a variety of different cancers receiving radiotherapy (n=100)	1) PMR 2) No intervention control	1) Numerical Pain Rating Scale (NPRS) 2) Cancer Fatigue Scale (CFS)	A significant reduction in pain and fatigue ($p<0.01$) were reported in the intervention group. Fatigue levels increased significantly in the control group ($p<0.01$)	Randomisation process unclear. It is not clear if the outcome measures used are validated scales
Pain and other symptoms	Haase et al 2005 (23)	RCT	Elderly colorectal carcinoma patients undergoing conventional resection (n=60)	1) PMR (audiotape only) and standard care 2) Guided imagery (audiotape only) and standard care 3) Control (no intervention)	1) Patient controlled analgesia (PCA) 2) Subjective pain intensity using VAS	Analgesic consumption ($P = 0.6$) and subjective pain intensity at rest ($P = 0.3$) and while coughing ($P = 0.3$) were not different between groups. Recovery of pulmonary function, duration of postoperative ileus, and subjective postoperative fatigue were also not influenced.	Some details of randomisation are missing. Sample size powered. Minimal loss to follow-up. Patients and investigators blinded as to which of the two interventions patient had received. PMR was audiotape only. Collected data on practice (average 10 times/week after surgery)

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Various symptoms	Kurt et al 2018 (25)	Non-randomised open label trial	Breast cancer patients undergoing chemotherapy (n=49)	1) PMR (face-to-face, once a day) 2) Treatment as usual (given PMR after the study)	1) Edmonton symptom diagnostic scale (ESDS)	The severity of pain, fatigue, nausea, sadness, anxiety, sleeplessness, lack of appetite, feeling bad, shortness of breath, change in skin and nails and mouth ulcers were significantly less in the intervention group than in the control group. The severity of these symptoms significantly increased in the control group ($p < 0.05$).	Not randomised (although groups were homogenous for demographics and disease characteristics). Sample size powered based on a pilot study. Used reminders etc to encourage PMR practice - participants practiced an average of 5.5 sessions/week for average of 21 mins/session. However, the reminders may have affected the outcomes