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Complete List of Authors:	Hobby, Julie; Griffith University Menzies Health Institute Queensland, ; Griffith University Griffith Health, Health Sciences and Social Work Crowley, Jennifer; The University of Auckland, Department of Nutrition & Dietetics, Faculty of Medical and Health Sciences Barnes, Katelyn; Griffith University Menzies Health Institute Queensland Mitchell, Lana; Griffith University Menzies Health Institute Queensland; Griffith University - Gold Coast Campus, School of Health Sciences and Social Work Parkinson, Joy; Griffith University Menzies Health Institute Queensland; Griffith University Griffith Business School, Department of Marketing Ball, Lauren; Griffith University Menzies Health Institute Queensland; Griffith University Griffith Health, School of Health Sciences and Social Work
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Effectiveness of interventions to improve health behaviours of health professionals: a systematic review.

Julie Hobby, PhD candidate [1,2] (0000-0003-2100-8151), Jennifer Crowley, research fellow [3] (0000-0003-1519-4429), Katelyn Barnes, research fellow [1] (0000-0001-5891-1331), Lana Mitchell, senior lecturer [1,2] (0000-0002-7892-2131), Joy Parkinson, associate professor [1,4] (0000-0001-6265-0277), Lauren Ball, associate professor [1,2] (0000-0002-5394-0931)

1. Menzies Health Institute Queensland, Griffith University, 170 Kessels Rd, Nathan, QLD 4111, Australia

2. School of Health Sciences and Social Work, Griffith University, Parklands Drive, Southport, Gold Coast QLD 4222, Australia

3. Department of Nutrition & Dietetics, Faculty of Medical and Health Sciences, University of Auckland, 85 Park Road, Grafton, Auckland 1023, New Zealand

4. Department of Marketing, Griffith Business School, Griffith University, 170 Kessels Rd, Nathan QLD 4111, Australia

Correspondence to: A/Prof Lauren Ball, Menzies Health Institute Queensland, Griffith University, Nathan, QLD 4111, Australia. Phone: +61 (0)7 3735 5244, Email: l.ball@griffith.edu.au

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Abstract

Objective

To evaluate the effectiveness of interventions designed to improve the health behaviours of health professionals.

Design

Systematic review.

Data sources

Database searches: MEDLINE, Cochrane library, EMBASE, and CINAHL

Review methods

This systematic review utilised PRISMA guidelines to compare randomised controlled trials (RCTs) of health professionals, which aimed to improve at least one health behaviour such as physical activity, diet, smoking status, mental health, and stress. Two independent reviewers screened articles, extracted data, and assessed quality of studies and reporting. The quality of articles was assessed using the Effective Public Health Practice Project quality assessment tool and the completeness of intervention reporting was assessed.

Outcome measures

The outcome assessed was change in behaviour between intervention and control groups from baseline to follow up.

Results

Nine studies met the eligibility criteria, totaling 1,107 participants. Health behaviours targeted were mental health and stress, physical activity, and smoking cessation, physical activity and nutrition. Six interventions observed significant improvements in the health behaviour in the intervention compared to control groups. Seven of the studies selected in person workshops as the mode of intervention delivery. The quality of the included studies was high with 80% (7/9) graded as moderate or strong.

Conclusions

Although high heterogeneity was found between interventions and outcomes, promising progress has occurred across a variety of health behaviours. Improving reporting and use of theories and models may improve effectiveness and evaluation of interventions. Further investigation is needed to recommend effective strategies.

Funding

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Registration

Registered with PROSPERO (ID: CRD42021238684).

Strengths and limitations of this study

- A strength of this review is that the highest quality study designs have been reviewed providing confidence in the findings of studies and the potential mechanisms of action or attributes which contribute to success.
- This systematic review is inclusive of health behaviours and allow future research to be informed by work done for a range of health behaivours.
- A limitation of this review is the high heterogeneity between interventions outcomes. For this reason, a descriptive approach has been employed to critically analysis the evidence in a way that can be used to inform future research and policy decisions.

Introduction

Health professionals are essential components of health services that provide support for individuals, communities, and society. Health professionals' personal health directly impacts their ability to provide safe and effective health services.[1] Health professionals are at higher risk of experiencing chronic health conditions and progression of disease[2] and are at increased risk of unhealthy coping mechanisms when compared to community members.[3,4] Initiatives that support healthy lifestyle behaviours of health professionals are clearly warranted.

The work environment of health professionals is increasingly demanding, with pressure to work longer hours and provide efficient and effective care.[5] Health professionals who directly interact with patients experience significant work-related psychological pressures and emotional exhaustion, placing them at risk of negative health outcomes.[3] The cumulative toll of these demands on health professionals is evident in their physical health, high rates of absenteeism, burnout, reduced clinical hours, and staff turnover.[1,6] The true financial cost of poor lifestyle beahviours on health professionals is poorly understood[6,7] but estimates from the USA indicate that the loss of clinical hours and turnover alone costs US$7600 per employed physician per year.[6] The COVID-19 epidemic has placed additional strain on health care systems and emphasized the importance of effective approaches to prevent health professional becoming secondary victims of this increased burden.[3] Efforts to support health professionals to improve their health can reduce these costs and enhance the quality of care.

The adoption of healthy lifestyles and the development of healthy coping mechanisms provide a sound foundation on which to increase resilience for the challenges faced in the workplace.[7] Key modifiable health behaviours such as low physical activity, poor diet and eating behaviours, smoking, and alcohol abuse are common causes of many health problems experienced by health professionals.[2] Understanding the most effective approaches to support lasting behaviour change is key to improving health professional's health. The aim of this systematic review is to identify and critically appraise interventions which aim to improve the health behaviours of health professionals.

Methods

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.[8] The review was registered with PROSPERO (ID: CRD42021238684). Due to the high heterogeneity expected in interventions and outcomes, this review employed a descriptive approach to identify and critically appraise interventions based on their outcomes and areas of behaviour change in a way that can be used to inform future research and policy decisions.

Search strategy and selection criteria

Searches of published scientific literature were conducted up to the 15th of January 2021 using the following databases: MEDLINE, Cochrane Library, EMBASE, CINAHL. Boolean connector AND was used to combine three search strings related to (i) health professionals/students, (ii) intervention and, (iii) specific intervention details. Boolean connector OR was used to combine search terms within each string, the full list of search terms is provided in Appendix 1. Studies with full text available, peer reviewed, published in English since 2010 were included. The studies were imported to Covidence[9] to assist in article management. The study selection process is illustrated in Figure 1.

Inclusion criteria were: 1) studies on health professionals of any age and profession, working in any health setting including tertiary, secondary or primary care, or residential care; 2) studies of interventions aimed to improve personal health behaviours of participants through either activities to modify behaviour within intervention sessions, such as the provision of food or participation in an exercise class, or influence behaviour through education and/or counselling; 3) studies assessing changes in health behaviours including diet, physical activity, and exercise, smoking and alcohol consumption, as well as wellbeing, mental health, and stress management; 4) studies using a randomised controlled design.

Exclusion criteria were: 1) studies with mixed populations where data of health professionals could not be separated from other populations, such as health professionals/students and administrative professionals in health environments; 2) studies where the primary intervention focused was not on health behaviour change; and 3) studies using non-randomised or cross-sectional designs.

Within Covidence, study titles and abstracts were screened in duplicate, independently by three members of the research team (JC, KB, LB). Full texts were retrieved for 138 articles that met inclusion criteria or required further information to decide. Full-text articles were screened against the selection criteria in duplicate by JC and KB. Disagreement on inclusion/exclusion were resolved by discussion with the research team until consensus. Reasons for exclusion are listed in Figure 1. Included articles' reference lists were searched for other relevant articles not identified in the search strategy.

Data analysis

Data for the included papers were extracted independently by two researchers (JH, LM, KB, JC) within Covidence using a template design specifically for the review. Data extracted included: country, aim, setting, number of intervention arms, number of participants, profession, attrition rate, intervention description (dose, intensity, and

description of activities), control group description, tools for outcome measures, follow up time points, behaviour change outcomes (changes in diet, physical activity, smoking or alcohol consumption), other outcomes of interest (body mass index (BMI), cholesterol, weight, mental health scores, stress scores, stage of change, process of change, and self-efficacy). Differences in the extracted data were reviewed and discussed by two researchers for consensus. No study authors were contacted for further information.

The focus of analysis was the difference in health behaviour change between intervention and control groups, such as a change in physical activity, dietary intake, smoking, or alcohol behaviours. Secondary outcomes were differences between the interventions and control groups in associated health outcomes such as weight, cholesterol, mental health and stress scores, or stage of change. Interventions were deemed to be effective if there was an observed statistically significant improvement in a health behaviour between intervention and control groups ($p<0.05$).

Quality assessment of included studies was conducted in duplicate by JH, JC, KB, LM using two tools: the Effective Public Health Practice Project (EPHPP) quality assessment tool[9] and the Template for Intervention Description and Replication (TIDieR).[10] Covidence was used to independently record quality assessment answers and supporting text. Conflicts in rating were resolved via team discussion and reviewed by LB and JP.

Role of the funding source

The funders of the study (NHMRC and Griffith University) had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The funders of this review had no known role in any study included in the review.

Patient and Public Involvement

No patient involved.

Ethics Approval

No ethics approval is required as only published studies are included in the review.

Results

The initial search identified 11,818 publications; 107 duplicate records were removed. Following title and abstract screening, 138 studies were assessed for eligibility using their full-text publication. The main reasons for exclusion, outlined in figure 1, were for assessing non-health behaviour outcomes (n=60), using non-RCT study designs (n=32), and not studying health professional populations (n=21). Citation searches of eligible studies identified one additional study for inclusion. Nine studies were eligible for inclusion.[11-19]

The characteristics of the nine studies included in the systematic review are outlined in Table 1. Four of the studies were conducted with nurses,[14-16,18,19] four were conducted on trainee physicians,[11-13,17] and one study included nurses, physiotherapists, and midwives.[18] Eight of the nine studies included participants without specific health conditions, while one study focused on participants with chronic lower back pain.[18] Over half of the studies (n=5) focused on early career, newly graduated or trainee health professionals.[11-13,16,17] Majority of participants were employed in large hospital settings,[11-15,17-19] with one study conducted in an academic medical center.[16] The studies

were conducted in the USA (n=4),[11,12,16,17] Australia (n=1),[13] Iran (n=1),[14] Spain (n=1),[15] Finland (n=1),[18] and Jordan (n=1).[19] Rates of attrition ranged between none to 22% (mean across all studies = 7.6%). All studies comprised one trial with two arms, apart from Saadat et al. (2012) with three arms[20] and Suni et al. (2018) with four arms.[18] Saadat et al. (2012) included an intervention group and two control groups, whereby one control group received no treatment with time off from duties and the other control group received no treatment and continued routine clinical duties.[17]

Table 1. Characteristics of included RCTs (n=9) examining health behaviour change in health professionals, ordered alphabetically by first author.

Author (year)	Country	Study Stated Aim	Population	Participants	Attrition Rate
Alkhawaldeh et al. (2020)[19]	Jordan	To evaluate the effectiveness of the stress management interventional program in reducing occupational stress and improving coping strategies.	Public health nurses	170	7·6%
Axisa et al. (2019)[13]	Australia	To evaluate the effectiveness of a workshop intervention to promote wellbeing for Australian physician trainees	Physician trainees of RACP	59	22%
Moosavi et al. (2017)[14]	Iran	To determine the effect of a TTM-based intervention on level of physical activity in ICU nurses	Nurses, working in ICU	68	0
Mujika et al. (2014)[15]	Spain	To test the efficacy, acceptability, and feasibility of a motivational interviewing based smoking cessation intervention with nurses.	Nurses, currently smoking	30	0
Saadat et al. (2012)[17]	USA	To evaluate the effects of implementing an evidenced-based, workplace preventive intervention with anesthesiology residents.	Anesthesiology residents	60	3%
Sampson et al. (2019)[16]	USA	To evaluate the effects of MINDBODYSTRONG for Healthcare Professionals Program on stress, anxiety, depressive symptoms, healthy lifestyle behaviors, and job satisfaction.	Nurses, residency program	93	4·3%
Suni et al. (2018)[18]	Finland	To investigate the effectiveness and cost-effectiveness of three intervention-arms (combined neuromuscular exercise and back care counselling or either alone) compared with non-treatment, for improvement of pain, ability to work and fear avoidance related to work/physical activity.	Female health workers with lower back pain (nurses, nurses' aides, specialist nurses, assistant physiotherapists, physiotherapists, & midwives)	219	19·6%
Thorndike et al. (2012)[12]	USA	To test the effectiveness of a nutrition and exercise maintenance intervention to preventing weight regain.	Residents, internal medicine & medicine/pediatric	304	9%
Thorndike et al. (2014)[11]	USA	To test use and access to activity monitor information in a hospital-based physical activity intervention to increase physical activity.	Residents, internal medicine & medicine/pediatric	104	4·8%

ICU = intensive care unit, RACP = Royal Australasian College of Physicians, TTM= transtheoretical model of behavioural change USA = United States of America

The description of interventions and outcomes are outlined in Table 2. Interventions targeted a single or combination of health behaviours. Health behaviours included physical activity (n=4),[11,12,14,18] diet (n=2),[11,12] stress management (n=4),[13,16,17,19] smoking cessation (n=1),[15] and alcohol use (n=1).[13] Techniques to change behaviour included

education and instructions on how to perform the health behaviour (n=9),[11-20] demonstration of health behaviours (n=2),[14,18] goal setting (n=4),[12,15,16,19] and environment change (n=2).[11,12] Environment changes included access to an onsite fitness centre along with personal training and staff nutritionist, as well as a catered meal provided weekly at a work seminar[11] or every 3 months in a group seminar[12].

Table 2. Description of health behaviour change interventions and outcomes of included RCTs (n=9), ordered alphabetically by first author.

Authors (year)	Study sessions/delivered by	Follow up	Activity Description	Comparator	Primary Outcome Assessed	Secondary Outcomes Assessed	Effectiveness	Quality Rating
Alkhawaldeh et al. (2020)[19]	12 sessions over 2 weeks (2/day for 3 days/week). Delivered by specialised mental health nurse.	2 months post intervention	2 hour sessions on stress, skills in stress management techniques, cognitive change, & behaviours to cope with stress & avoid negative outcomes from stress.	No intervention	Occupational stress via Nurses Stress Scale. Coping strategies via Brief-COPE Scale.	Not applicable	Significant improvement among intervention group compared to control group for total occupational stress scores, total coping strategies scale scores.	Strong
Axisa et al. (2019)[13]	1 workshop. Delivered by - study trained specialist clinician.	3 & 6 months post intervention	4 hour workshop on wellbeing, health & stress management techniques.	No intervention	Alcohol use via AUDIT. Depression, anxiety & stress via DASS-21. Secondary traumatic stress & compassion satisfaction via ProQOL.	Not applicable	No significant difference was found between intervention and control.	Weak
Moosavi et al. (2017)[14]	2 sessions delivered on the same day. Delivered by - research team and sports coach.	None	1 hour CBT session for coping mechanisms, benefit of PA, time management for PA, PA strategies. 1 hour practical exercise training session. Isometric exercise CD to be used at home for 30 mins/day.	Not reported	Physical activity via MET minutes/week questionnaire.	Stages of change (SoC). Self-Efficacy Scale. Decisional Balance Questionnaire Process of change.	Significant improvement among intervention group compared to control group for: MET scores, SOC, POC, Self-efficacy, perceived benefits of PA.	Weak
Mujika et al. (2014)[15]	4 sessions over 4 weeks. Delivered by - therapist.	3 months post intervention.	1 hour session/week of patient centred MI sessions.	Brief anti-smoking advice based on the 5As.	Smoking cessation verified biochemically via urine cotinine & expired carbon monoxide.	Mean number of cigarettes smoked via self-reporting. Nicotine dependence via FTND. Stages of change via SOCQ.	Significant improvement among intervention group compared to control group for smoking cessation, mean no. of cigarettes per day, SOC, depression scores.	Moderate

						Self-efficacy via general self-efficacy test. Depression score via PHQ-9.		
Saadat et al. (2012)[17]	16 sessions over 16 weeks. Delivered by – research team including anesthesiologists, epidemiologist and psychiatrists.	None	1.5h/week CBT based sessions with 4 components on coping with work & family stress.	Group 1 had workshop rostered time off. Group 2 continued routine clinical duties (RD).	Job/family stress via 48 item (RQS) Coping strategies via self-reporting. Social support via an adaption of PSS. Anxiety via STAI. Depression via CESD. Physical symptoms via CHIPS. Alcohol & tobacco use via NSDUH.	Not applicable	Significant improvement among intervention group compared to control group 2 for anxiety score, perceived stress as a parent, **c**oping: problem-solving scores. Significant improvement among intervention compared to both control groups (groups 1 and 2) for social support at work scores.	Moderate
Sampson et al. (2019)[16]	8 sessions over 8 weeks. Delivered by not reported.	3 months post intervention	45min/week MINDBODYSTRONG sessions on: caring for the mind, caring for the body, & skills building. CBT concepts to establish weekly goals, & complete skills-building activities weekly.	Usual nurse curriculum (45min debrief/week on successes & challenges + group support).	Perceived stress via PSS. Anxiety via GAD-7. Depressive symptoms via the 9-item Personal Health Questionnaire. Healthy lifestyle beliefs & healthy lifestyle behaviours via adaption of beliefs scales by Melnyk and colleagues. Job satisfaction via JSS.	Not applicable	Significant improvement among intervention group compared to control group for perceived stress, anxiety scores, depressive symptoms scores, healthy lifestyle behaviours scores.	Strong
Suni et al. (2018)[18]	48 sessions over 24 weeks. Delivered by certified Pilates instructors	6 months post intervention	1 hour/ 2x per week. A modified Pilates-type	No intervention	Intensity of lower back pain measured with the	Bodily pain interfering with work (via GLMM).	Significant improvement for only the combined (exercise + counselling) arm	Strong

	with a degree in physiotherapy/ masters in health science or both.		exercise program, 3 stages of progressive difficulty. An additional 10 x 45 min counselling sessions were given exercise + counselling arm. CBT was used for the framework & PBL used to implement counselling sessions.		Visual Analog Scale (VAS, 0–100 mm).	FABs related to work/PA (via GLMM). Cost-effectiveness ratio calculated from difference in mean total costs & mean effect (no. sick days or QALYs) between arms.	in intensity of LBP, pain interfering with work, FABs related to work. Significant improvement for only the exercise-arm in FABs related to PA. Significant improvement for only the combined (exercise + counselling) arm in cost effectiveness -costs of sickness absences and total costs during the total study period.	
Thorndike et al. (2012)[I2]	6 optional sessions over 9 months. Up to 3 sessions each delivered by study nutritionist or personal trainer.	None	Intervention via website – PA & nutrition goals set weekly (monitored by nutritionist). Every 3 months option for face-to-face nutrition and/or PT session & a lunch-time group seminar.	No intervention	Weight loss, % weight loss. PA via estimate of intensity level & minutes spent in PA per week.	Diet via FFQ. BMI, waist circumference, BP, cholesterol, fasting serum glucose.	No significant difference was found between intervention and control.	Moderate
Thorndike et al. (2014)[I1]	24 (optional sessions) over 6 weeks. Up to 12 sessions delivered by each staff nutritionist or personal trainer.	6 months	Received workplace health program + access to PA monitor.	Control group received workplace health program + blinded PA monitor.	PA measured in steps via activity monitor (Fitbit).	Compliance with wearing the monitor.	No significant difference was found between intervention and control.	Moderate

AUDIT = Alcohol Use Disorder Identification Test, BMI = body mass index, BP = blood pressure, CBT = Cognitive behavioural theory, CESD = The Center of Epidemiologic Studies Depression scale, CHIPS = Cohen-Hoberman Inventory of Physical Symptoms, DASS-21 = Depression Anxiety Stress Scale – 21 item, FAB= fear avoidance behaviour , FFQ = food frequency questionnaire, FTND= Fagerström Test for Nicotine Dependence, GAD-7 = Generalized Anxiety Disorder Scale, , GLMM = generalized linear mixed model, , JSS = job satisfaction scale, MET= Metabolic Equivalent of Task scale, , MI = motivational interviewing, NSDUH = National Survey on Drug Use and Health, PA = Physical activity, PBL = problem-based learning, , PHQ-9 = The Patient Health Questionnaire – 9 items, POC = process of change, ProQOL= Professional Quality of Life scale, PSS= perceived stress scale, PT = personal trainer, QALY = quality-adjusted life-year, RQS = role quality scale, SOCQ = stage of change questionnaire, STAI = State-Trait Anxiety Inventory, VAS = visual analog scale.

The intervention components were frequently underpinned by behaviour change theory and the delivery methods varied widely. Behaviour change theories and models used in interventions included: cognitive behavioural theory (n= 4),[14,16-18] transtheoretical/stage of change model (n=2),[14,15] motivational interviewing combined with cognitive dissonance theory (n=1),[15] Pearlin and Schooler's hierarchy of coping mechanisms (n=1),[17] and Folkman and colleagues cognitive theory of stress and coping (n=1).[19] Reporting on how the theory unpinning the interventions varied, with five reporting how the theory was applied to the interventions,[13-16,18] two did not include details on how theory was applied,[17,19] and in two theory was not applied.[11,12] Implementation of interventions was often poorly described including lack of information about delivery tools, resources, and training/qualifications of intervention providers. Two studies[11,15] provided the intervention only through individual sessions, the remaining studies utilised a group setting.

The intensity of sessions and length of interventions varied from 4 to 130 hours over time periods of half a day up to 9 months. The frequency of delivery included one-off sessions (2-4 hours in length) (n=2),[13,14] 1 hour sessions each week (n=3),[15-17] 1 hour sessions twice a week (n=1),[17] and 4 hour sessions 3 times a week (n=1).[19] In person contact with participants varied across interventions with four studies having minimal in person contact following the initial intervention instructions, two had no in person contact until the 6 month follow up[13,14] and two had contact via email or website until follow up[11] or group meeting at three months.[12] Two interventions used technology to contact and prompt participants on physical activity and/or nutrition goals, via monthly email and/or website access.[11,12] Length of time until follow up ranged from no follow up (n=3),[12,14,17] 2 months post intervention (n=1),[19] 3 months post intervention (n=3),[13,15,16] and 6 months post intervention (n=2).[11,18]

The outcome measures varied between the studies. In one study physical activity was measured in steps via an activity monitor,[11] in another study estimated intensity and minutes spent in physical activity per week in the last three months,[12] and in another study the Metabolic Equivalent of the Task (MET) scale through a questionnaire or physical activity per week.[14] In one study, dietary behaviour was assessed via a food frequency questionnaire to estimate the number of serves from major food groups per day during the previous month, and body weight was measured with the percentage of weight loss calculated.[12] In one study, self-reported smoking cessation was confirmed through biochemical measures (urine cotinine and expired carbon monoxide).[15] In one study, changes in lower back pain were measured using the visual analog scale (0 to100mm).[18] Four studies assessed mental health and stress outcomes, using different tools to measure stress, coping, depression and anxiety, which included the Nurses Stress Scale (NSS),[19] the Brief-COPE scale,[19] Perceived Stress Scale (PPS),[16] Professional Quality of Life scale (ProOOL),[13] Job Satisfaction scale (JJS),[16] Generalized Anxiety Disorder Scale (GAD-7),[16] Depression Anxiety Stress Scale (DASS-21),[13] the Center of Epidemiologic Studies Depression scale (CESD),[17] State-Trait Anxiety Inventory (STAI).[17] The two studies that assessed alcohol used the National Survey on Drug Use and Health (NSDUH)[17] survey or an adaption of the Alcohol Use Disorder Identification Test (AUDIT).[13] One study measured cigarette use using the Fagerström Test for Nicotine Dependence, which contains 6 items for quantity, compulsion, and dependence.[15] Finally, one study used the Cohen-Hoberman Inventory of Physical Symptoms

(CHIPS) which uses a 5-point Likert scale to measure the burden of physical symptoms resulting from psychological effects.[17]

Six of the nine studies (n=8 interventions) observed statistically significant outcomes between the intervention and control group.[14-19] Of these, three were wellbeing interventions with mental health and stress-related outcomes,[16,17,19] two were physical activity interventions[14,18] and one was a smoking cessation intervention.[15] Four of the effective interventions were delivered only through education and counselling on health behaviours, one for smoking cessation[15] and three for stress management behaviour.[13,17,19] From a four-armed study, the exercise combined with counselling was more effective at reducing lower back pain than the intervention arms providing only exercise or counselling.[18] One study combined education and instructions to conduct exercises at home for six months and significantly reduced MET scores (intervention 2813.06 (SD 3172.58), control 1196.47 (SD 1441.29), p=0.02).[14]

Of studies that measured readiness or preparation to change behaviour (n=2),[14,15] significant improvement was observed in the intervention groups, with participants progressing from preparation and contemplation stages to action and maintenance.[14,15] In one study, the stage of change for physical activity improved, resulting in 91.2% at the stage of action and 5.9% at the stage of maintenance (p = 0.0001), while the control group remained relatively constant with only 5.9% in the action stage and none in the maintenance stage (p = 0.002).[14] Similar progression in the stages of change occurred in the other study targeting smoking cessation, with the majority of participants in the intervention group progressing to preparation and action stages, 20% and 46% respectively, compared to most participants in the control group remaining in the pre-contemplation and contemplation stages (preparation stage intervention 47% vs control none, p=0.01, action stage intervention 40% vs control 3%, p=0.01).[15]

Of the three wellbeing interventions with a focus on mental health and/or stress management, all reported statistically significant reductions in stress and anxiety.[16,17,19] One study observed lower depressive scores in the intervention group when compared to the control group[16] while another study used two control groups, with one group released from duties (rostered time off) for the duration of the workshop (one hour) while the other group continued routine clinical duties (RD).[17] Statistically significant improvements occurred only between the intervention and the control group not released from duties with lower scores for anxiety (intervention 38.4 vs RD control 45.6, p = 0.02), perceived stress as a parent (intervention 21.7 vs RD control 24.1, p = 0.03), and increased coping scores (intervention 27.7 vs RD control 27.1, p = 0.03).[17] The only effective outcome improved in the intervention group compared to both control groups was perceived social support at work (intervention 27.3 vs RD control 26.7 and rostered time off control 25.5, p = 0.02).[17]

The Effective Public Health Practice Project tool was used to assess the quality of each of the studies, with the summary of ratings presented in Table 3 (Appendix 2). Of the nine studies, three were rated as strong,[16,18,19] four as moderate,[11,12,15,17] and two as weak.[13,14] The components in which interventions received a low score were study blinding,[11-15,17] not controlling for confounders,[13,14] or selection bias.[15]

The TIDieR checklist report is shown in Figure 2. Checklist items 2 to 8 were consistently reported on the primary publication for 73% of the included interventions. Checklist items 9 to 11 were not reported across most

interventions. These items related to reporting on tailoring, modification, how well planned the interventions were, and how they were implemented. No interventions reported tailoring or modifications, two interventions[11,15] reported intended plans to check how well the intervention delivery adhered to plan, while only one study measured and reported how well the intervention was delivered.[11] Overall, information for 49.5% of 11 of the checklist items (items 2-12) was provided on the primary paper.

Discussion

This systematic review has identified a modest collection of heterogeneous studies that show strong promise in enabling improvements in health professionals' personal health behaviours. The professions included trainee physicians, nurses, physiotherapists, and midwives, targeting behaviours related to physical activity, nutrition, stress management, and coping strategies to improve anxiety and depression. Overall, most studies demonstrated significant improvements in health behaviours, which is encouraging and worthy of further investigation given the considerable cost related to poor health of health professionals.[6] Despite the heterogeneity of studies, significant progress was found for both direct and indirect behaviour change interventions.

Intervention mode and intensity were key ways that studies were heterogeneous. The most common mode and intensity was in person contact at least once a week. Higher intensity of contact has been shown to increase effectiveness in physical activity interventions.[21] While increased intensity of contact with participants may increase the cost of interventions,[22] a cost effective approach to increase contact has been demonstrated through technology.[23] The use of technology amongst the reviewed studies was limited and the intensity of use was minimal at once a week and/or month,[11] or every three months.[12] Prior studies have noted[21,24] the optimal intensity via technology is between three to five text messages a day[21] and that technology intervention messages require extensive tailoring of content (e.g., to match the stage of change etc.).[21,25] These findings suggest that increasing the intensity of contact with participants may enhance interventions, and the use of technology could be further explored as a cost effective approach.

The included studies involved sessions to raise awareness and/or build knowledge amongst participants. The findings of the review suggest that the effectiveness of interventions was enhanced when counselling or group education workshops were used in combination with activities or approaches which required participants to perform behaviours. This is consistent with previous studies in behaviour change in other populations where effectiveness was enhanced by incorporating factors that aim to promote and support the performance of behaviours and engagement in self-regulation techniques (e.g. goal setting, self-monitoring).[21,26] These findings support the importance of combining activities to raise awareness with those that promote action and performance of behaviours to increase the likelihood of change.

Interventions designed for health professionals need to allow for many interacting factors due to differences between work pressures, settings, access to support and resources and these factors increase the complexity of planning and tailoring of interventions to effectively promote behaviour change. The use of theory to underpin interventions can provide a practical means to approach these difficulties and evaluate outcomes.[27] Across the review, studies used a variety of theories and models including the stages of change model,[28] motivational interviewing,[29] and cognitive

behavioural therapy.[30] Previous studies have shown that combining theories and approaches has been effective in changing health behaviors.[26] Reporting on how interventions are mapped to the underpinning theory is required to improve reproducibility of successful interventions.[26,31]Including a model to classify progress across interventions may also capture more subtle changes and improve strategies for addressing and/or measuring relapse and maintenance of changes.[32] Behaviour change can be challenging to sustain with some individuals experiencing several relapses when attempting to maintain new health behaviors.[21,26,32] Collectively, the evidence suggests that the use of a combination of theories and approaches, can provide a means to design, implement and evaluate interventions to best meet the specific challenges of the health setting and facilitate sustainable change.

The follow-up activities and duration of studies varied widely. It has been suggested that a key time where individuals are likely to experience behaviour change relapse is in the first six months.[32,33] The reviewed interventions may be failing to capture the patterns of behaviour maintenance and relapse occurring within the first six months following the intervention. Follow-up is important to establish if the intervention is effective at maintaining behavior change beyond the life of the intervention.[33] Previous studies indicate that a minimum, collection of follow-up data at 6 months post participation is ideal to assess maintenance of behaviour change.[33] To further increase understanding of program effectiveness, there is a need for follow-up at 12 months and 24 months post program.[33,34]

This review has highlighted a number of gaps which may be addressed in future research. The reviewed interventions were focused on a limited number or specific professional groups. Extending inclusion of intervention activities to a diverse group of health professions may increase social support and promote greater team connectedness.[21,35] Dietary behaviour was only addressed in one intervention, and as diet has a significant influence on health, interventions to support healthy dietary behaviours may be worthy of being prioritised. Evaluation of cost effectiveness was also limited. Comparing intervention cost to improvement in quality of life and reduced staff turnover and absenteeism can make interventions more likely to be worthy of implementation. Factors which support action such as social support are important areas to be addressed to improve the effectiveness of interventions.[21] Overall, the progress achieved across a variety of behaviours is promising and key gaps have been highlighted, although determining the future direction for interventions for health professionals may be challenging.

To advance the evidence consistent reporting methods with consensus on ideal outcomes for tracking specific health behaviours are needed. Improving the reporting of behaviour change strategies, their associated theories and models, and their outcomes will enhance future intervention design. Additionally, integrating monitoring and evaluation measures into intervention design including measures of behaviour maintenance and intervention cost effectiveness will provide a strong evidence base on which to develop future interventions.

Contributors

JH, JC, KB, LM and LB accessed and verified the study data. LB conceived and designed the review. JH analysed the data and interpreted the data. JH wrote the first draft of the manuscript with input from JC, KB and JP. All

authors critically revised the manuscript for intellectual content. LB and JP supervised the study. All authors had access to data and had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Declaration of interests

We have read and understood the BMJ policy on declaration of interests and declare the following interests: None.

Data sharing

Data can be requested from the corresponding author.

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Figure 1. PRISMA flowchart of study selection.

Figure 2. Percentage of RCT (n=9) with adequate TIDieR items (2-12) reported in the original study, additional sources or not reported.

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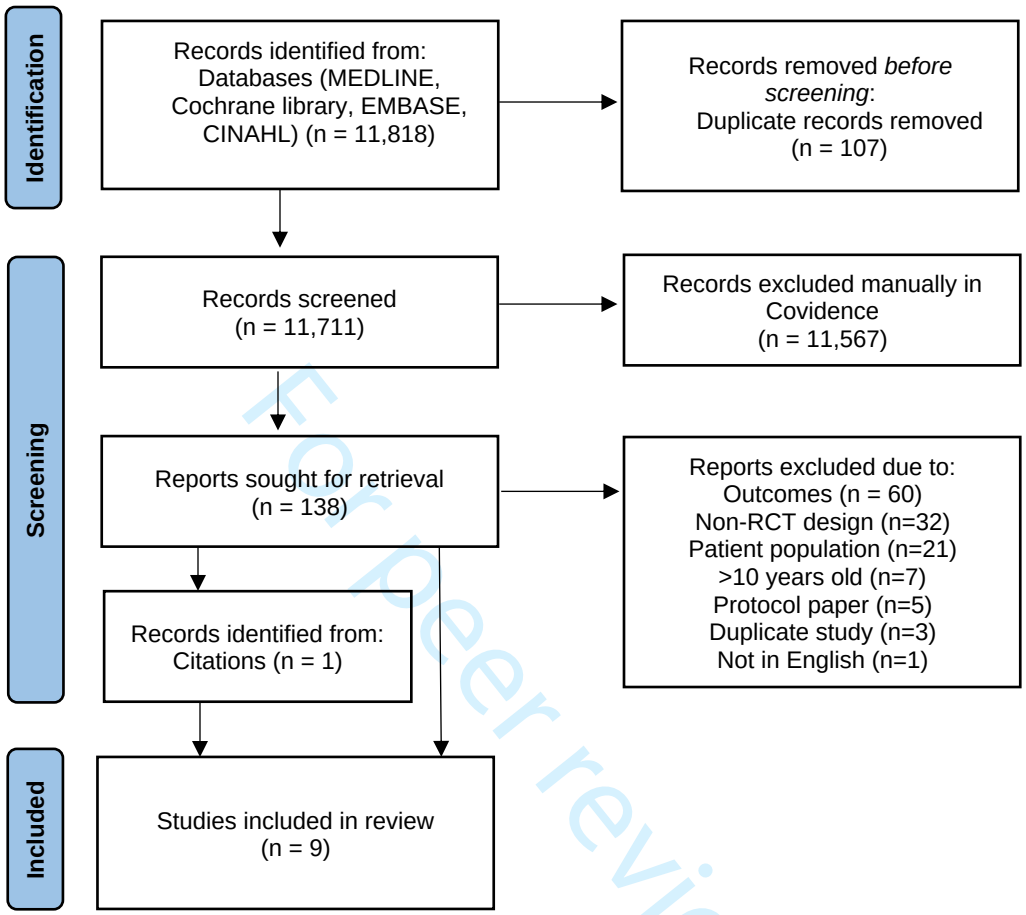

Figure 1. PRISMA flowchart of study selection.

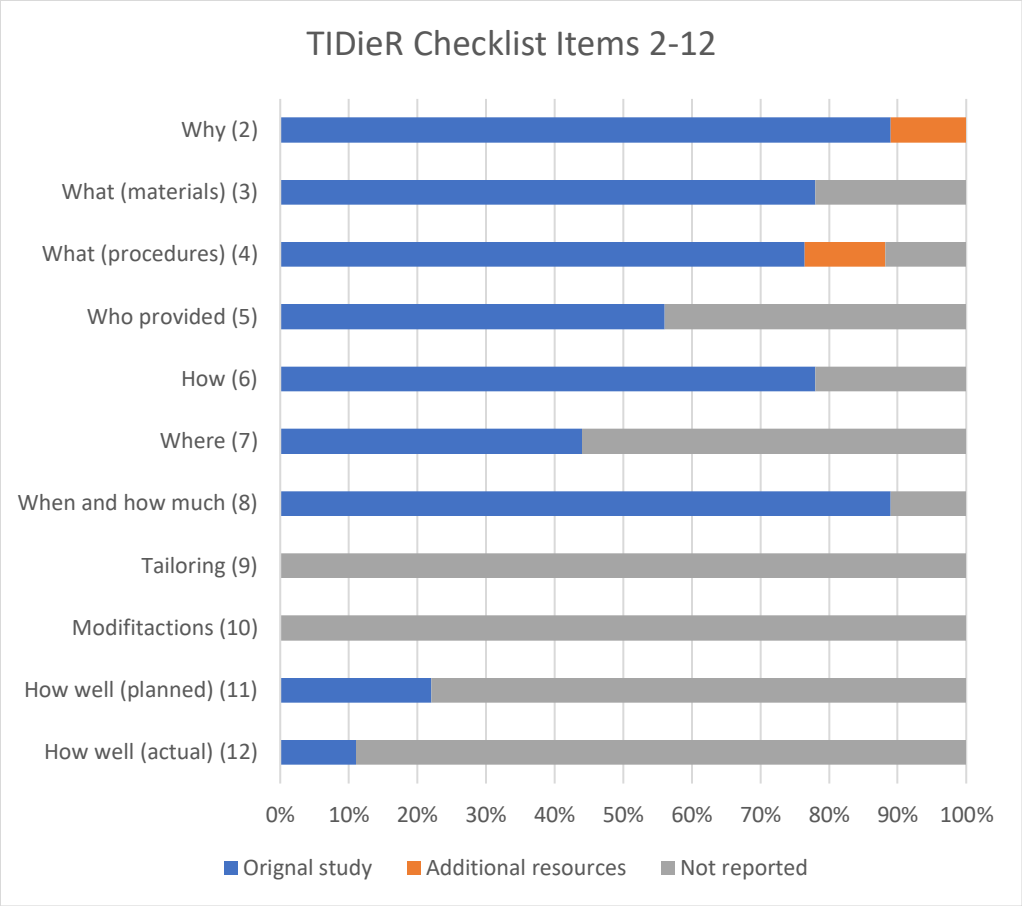

Figure 2. Percentage of RCT (n=9) with adequate TIDieR items (2-12) reported in the original study, additional sources or not reported.

Supplementary material

Appendix 1

Searches: The following electronic databases will be searched (MEDLINE, Cochrane library, EMBASE, CINAHL). Boolean connectors AND will be used to combine three search categories related to (i) health professionals/students, (ii) intervention and (iii) specific intervention details. Boolean connectors OR will be used to combine search terms within each category.

I. Search terms related to health professionals include: “health professional*” OR resident* OR consultant* OR registrar* OR “healthcare professional*” OR “health student*” OR “healthcare student*” OR “healthcare worker*” OR “health clinician*” OR “healthcare clinician*” OR nurse* OR “student nurse*” OR “nurse student*” OR “nurse professional*” OR doctor* OR “student doctor*” OR “doctor student*” OR “medical professional*” OR “medical student*” OR “general practitioner*” OR dietitian* OR dietician* OR “dietician student*” OR “dietitian student*” OR “student dietitian*” OR “student dietician*” OR “dietetic student*” OR nutritionist* OR “nutrition student*” OR “student nutritionist*” OR pharmacist* OR “student pharmacist*” OR “pharmacy student*” OR physiotherapist* OR “physiotherapy student*” OR “student physiotherapist*” OR psychologist* OR “psychology student*” OR “student psychologist*” OR “occupational therapist*” OR “student occupational therapist*” OR (MH "Nurses") OR (MH "Nurses, Public Health") OR (MH "Nurses, Male") OR (MH "Nurses, International") OR (MH "Nurses, Community Health") OR (MH "Nurse Specialists") OR (MH "Nurses, Pediatric") OR (MH "Nurse Midwives") OR (MH "Nurse Clinicians") OR (MH "Nurse Anesthetists") OR (MH "Nurse Practitioners") OR (MH "Pediatric Nurse Practitioners") OR (MH "Family Nurse Practitioners") OR (MH "Nursing+") OR (MH "Physicians") OR (MH "Urologists") OR (MH "Radiologists") OR (MH "Surgeons+") OR (MH "Oncologists+") OR (MH "Neurologists") OR (MH "Nephrologists") OR (MH "Geriatricians") OR (MH "General Practitioners") OR (MH "Gastroenterologists") OR (MH "Endocrinologists") OR (MH "Dermatologists") OR (MH "Cardiologists") OR (MH "Anesthesiologists") OR (MH "Allergists") OR (MH "Pharmacists") OR (MH "Occupational Therapists") OR (MH "Nutritionists") OR (MH "Anesthetists+") (MH "Medical Staff+") OR (MH "Nursing Staff+") OR (MH "Physical Therapists") OR (MH "Students, Medical") OR (MH "Students, Pharmacy") OR (MH "Students, Nursing")

i. Search terms related to the intervention include: “randomized controlled trial” OR (MH "Randomized Controlled Trial") OR “controlled clinical trial” OR randomized OR randomised OR randomly OR “pre-post”

ii. Search terms related to the specific intervention details include: “physical activity” OR exercise OR fitness OR nutrition OR “eating habits” OR “dietary habits” OR “food intake” OR “dietary intake” OR “dietary change” OR “healthy eating” OR “dietary behavior” OR “dietary behaviour” OR eating OR smoking OR “smoking cessation” OR “quitting smoking” OR “quit smoking” OR alcohol OR (MH "Exercise+") OR

(MH “Healthy Lifestyle+”) OR (MH "Smoking Cessation") OR (MH "Smoking+") OR (MH "Smoking Reduction") OR (MH “Alcohol Drinking+”)

Appendix 2

Risk of bias assessments (TIDieR checklist figure 2 and EPHPP table 3).

Table 3. The Effective Public Health Practiced Project (EPHPP) checklist criteria for each study (n=9).

	Selection Bias	Study Design	Confounders	Blinding	Data collection	Withdrawal and dropout	Overall Rating*
Alkhawaldeh et al. (2020)	Moderate	Strong	Strong	Moderate	Strong	Strong	Strong
Axisa et al. (2019)	Moderate	Strong	Weak	Weak	Strong	Moderate	Weak
Moosavi et al. (2017)	Strong	Moderate	Weak	Weak	Strong	Strong	Weak
Mujika et al. (2014)	Weak	Strong	Moderate	Strong	Strong	Strong	Moderate
Saadat et al. (2012)	Moderate	Moderate	Strong	Weak	Moderate	Strong	Moderate
Sampson et al. (2019)	Strong	Moderate	Strong	Strong	Strong	Strong	Strong
Suni et al. (2018)	Strong	Strong	Strong	Moderate	Strong	Strong	Strong
Thorndike et al. (2014)	Strong	Strong	Strong	Weak	Strong	Strong	Moderate
Thorndikeet al. (2012)	Strong	Strong	Strong	Weak	Strong	Strong	Moderate

*Overall rating based on Strong = 0 weak scores, Moderate = 1 weak score, Weak = ≥ 2 weak scores.

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	pg 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Pg 1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Pg 1-2
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Pg 2
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Pg 2
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Pg 2
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Pg 2
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Pg 2
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Pg 2
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Pg 2-3
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Pg 3
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Pg 3
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Pg 3
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	na
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	na
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	na
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	na
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	na
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	na
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Pg 3
Certainty	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	na

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
assessment			
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Pg 4
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Pg 4
Study characteristics	17	Cite each included study and present its characteristics.	Pg 5
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Pg 12
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Pg 5 - 12
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	na
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	na
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Pg 5-12
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	na
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Pg 12
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	na
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Pg 13
	23b	Discuss any limitations of the evidence included in the review.	Pg 14
	23c	Discuss any limitations of the review processes used.	Pg 14
	23d	Discuss implications of the results for practice, policy, and future research.	Pg 14
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Pg 1
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Pg 1
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	na
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Pg 1 & 4
Competing interests	26	Declare any competing interests of review authors.	Pg 3 & 14
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Request to corresponding author

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi:

PRISMA 2020 Checklist

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Secondary Subject Heading:	Health services research
Keywords:	EDUCATION & TRAINING (see Medical Education & Training), PRIMARY CARE, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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Effectiveness of interventions to improve health behaviours of health professionals: a systematic review.

Julie Hobby, PhD candidate [1,2] (0000-0003-2100-8151), Jennifer Crowley, research fellow [3] (0000-0003-1519-4429), Katelyn Barnes, research fellow [1] (0000-0001-5891-1331), Lana Mitchell, senior lecturer [1,2] (0000-0002-7892-2131), Joy Parkinson, associate professor [1,4] (0000-0001-6265-0277), Lauren Ball, associate professor [1,2] (0000-0002-5394-0931)

1. Menzies Health Institute Queensland, Griffith University, 170 Kessels Rd, Nathan, QLD 4111, Australia

2. School of Health Sciences and Social Work, Griffith University, Parklands Drive, Southport, Gold Coast QLD 4222, Australia

3. Department of Nutrition & Dietetics, Faculty of Medical and Health Sciences, University of Auckland, 85 Park Road, Grafton, Auckland 1023, New Zealand

4. Department of Marketing, Griffith Business School, Griffith University, 170 Kessels Rd, Nathan QLD 4111, Australia

Correspondence to: A/Prof Lauren Ball, Menzies Health Institute Queensland, Griffith University, Nathan, QLD 4111, Australia. Phone: +61 (0)7 3735 5244, Email: l.ball@griffith.edu.au

Word count:3660

Abstract

Objective

To evaluate the effectiveness of interventions designed to improve the health behaviours of health professionals.

Design

Systematic review.

Data sources

Database searches: MEDLINE, Cochrane library, EMBASE, and CINAHL

Review methods

This systematic review utilised PRISMA guidelines to compare randomised controlled trials (RCTs) of health professionals, published between 2010-2021, which aimed to improve at least one health behaviour such as physical activity, diet, smoking status, mental health, and stress. Two independent reviewers screened articles, extracted data, and assessed quality of studies and reporting. The quality of articles was assessed using the Effective Public Health Practice Project quality assessment tool and the completeness of intervention reporting was assessed.

Outcome measures

The outcome assessed was change in behaviour between intervention and control groups from baseline to follow up.

Results

Nine studies met the eligibility criteria, totaling 1,107 participants. Health behaviours targeted were mental health and stress, physical activity, and smoking cessation, physical activity and nutrition. Six interventions observed significant improvements in the health behaviour in the intervention compared to control groups. Seven of the studies selected in person workshops as the mode of intervention delivery. The quality of the included studies was high with 80% (7/9) graded as moderate or strong.

Conclusions

Although high heterogeneity was found between interventions and outcomes, promising progress has occurred across a variety of health behaviours. Improving reporting and use of theories and models may improve effectiveness and evaluation of interventions. Further investigation is needed to recommend effective strategies.

Registration

Registered with PROSPERO (ID: CRD42021238684).

Strengths and limitations of this study

- A strength is that the highest quality study designs (Randomised Controlled Trials) have been reviewed providing confidence in the findings of studies and the potential mechanisms of action or attributes which contribute to success.
- A strength is that an inclusive definition of health behaviours was used to allow future research to be informed by work done for a range of health behaivours.
- A limitation is that the inclusive nature of interventions meant high heterogeneity existed between interventions outcomes, preventing a quantitative meta-analysis from being possible.

Introduction

Health professionals are essential components of health services that provide support for individuals, communities, and society. Health professionals' personal health directly impacts their ability to provide safe and effective health services.[1] Health professionals are at higher risk of experiencing chronic health conditions and progression of disease[2] and are at increased risk of unhealthy coping mechanisms when compared to community members.[3,4] Initiatives that support healthy lifestyle behaviours of health professionals are clearly warranted.

The work environment of health professionals is increasingly demanding, with pressure to work longer hours and provide efficient and effective care.[5] Health professionals who directly interact with patients experience significant work-related psychological pressures and emotional exhaustion, placing them at risk of negative health outcomes.[3] The cumulative toll of these demands on health professionals is evident in their physical health, high rates of absenteeism, burnout, reduced clinical hours, and staff turnover.[1,6] The true financial cost of poor lifestyle beahviours on health professionals is poorly understood[6,7] but estimates from the USA indicate that the loss of clinical hours and turnover alone costs US$7600 per employed physician per year.[6] The COVID-19 epidemic has placed additional strain on health care systems and emphasized the importance of effective approaches to prevent health professional becoming secondary victims of this increased burden.[3] Efforts to support health professionals to improve their health can reduce these costs and enhance the quality of care.

The adoption of healthy lifestyles and the development of healthy coping mechanisms provide a sound foundation on which to increase resilience for the challenges faced in the workplace.[7] Key modifiable health behaviours such as low physical activity, poor diet and eating behaviours, smoking, and alcohol abuse are common causes of many health problems experienced by health professionals.[2] Understanding the most effective approaches to support lasting behaviour change is key to improving health professional's health. The aim of this systematic review is to identify and critically appraise interventions which aim to improve the health behaviours of health professionals.

Methods

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.[8] The review was registered with PROSPERO (ID: CRD42021238684). Due to the

high heterogeneity expected in interventions and outcomes, this review employed a descriptive approach to identify and critically appraise interventions based on their outcomes and areas of behaviour change in a way that can be used to inform future research and policy decisions.

Search strategy and selection criteria

Searches of published scientific literature were conducted up to the 15th of January 2021 using the following databases: MEDLINE, Cochrane Library, EMBASE, CINAHL. Boolean connector AND was used to combine three search strings related to (i) health professionals/students, (ii) intervention and, (iii) specific intervention details. Boolean connector OR was used to combine search terms within each string, the full list of search terms is provided in Appendix 1. Studies with full text available, peer reviewed, published in English since 2010 were included. The studies were imported to Covidence[9] to assist in article management. The study selection process is illustrated in Figure 1.

Inclusion criteria were: 1) studies on health professionals of any age and profession, working in any health setting including tertiary, secondary or primary care, or residential care; 2) studies of interventions aimed to improve personal health behaviours of participants through either activities to modify behaviour within intervention sessions, such as the provision of food or participation in an exercise class, or influence behaviour through education and/or counselling; 3) studies assessing changes in health behaviours including diet, physical activity, and exercise, smoking and alcohol consumption, as well as wellbeing, mental health, and stress management; 4) studies using a randomised controlled design.

Exclusion criteria were: 1) studies with mixed populations where data of health professionals could not be separated from other populations, such as health professionals/students and administrative professionals in health environments; 2) studies where the primary intervention focused was not on health behaviour change; and 3) studies using non-randomised or cross-sectional designs.

Within Covidence, study titles and abstracts were screened in duplicate, independently by three members of the research team (JC, KB, LB). Full texts were retrieved for 138 articles that met inclusion criteria or required further information to decide. Full-text articles were screened against the selection criteria in duplicate by JC and KB. Disagreement on inclusion/exclusion were resolved by discussion with the research team until consensus. Reasons for exclusion are listed in Figure 1. Included articles' reference lists were searched for other relevant articles not identified in the search strategy.

Data analysis

Data for the included papers were extracted independently by two researchers (JH, LM, KB, JC) within Covidence using a template design specifically for the review. Data extracted included: country, aim, setting, number of intervention arms, number of participants, profession, attrition rate, intervention description (dose, intensity, and description of activities), control group description, tools for outcome measures, follow up time points, behaviour change outcomes (changes in diet, physical activity, smoking or alcohol consumption), other outcomes of interest (body mass index (BMI), cholesterol, weight, mental health scores, stress scores, stage of change, process of change,

and self-efficacy). Differences in the extracted data were reviewed and discussed by two researchers for consensus. No study authors were contacted for further information.

The focus of analysis was the difference in health behaviour change between intervention and control groups, such as a change in physical activity, dietary intake, smoking, or alcohol behaviours. Secondary outcomes were differences between the interventions and control groups in associated health outcomes such as weight, cholesterol, mental health and stress scores, or stage of change. Interventions were deemed to be effective if there was an observed statistically significant improvement in a health behaviour between intervention and control groups ($p<0.05$).

Quality assessment of included studies was conducted in duplicate by JH, JC, KB, LM using two tools: the Effective Public Health Practice Project (EPHPP) quality assessment tool[9] and the Template for Intervention Description and Replication (TIDieR).[10] Covidence was used to independently record quality assessment answers and supporting text. Conflicts in rating were resolved via team discussion and reviewed by LB and JP.

Patient and public involvement

None

Results

The initial search identified 11,818 publications; 107 duplicate records were removed. Following title and abstract screening, 138 studies were assessed for eligibility using their full-text publication. The main reasons for exclusion, outlined in figure 1, were for assessing non-health behaviour outcomes (n=60), using non-RCT study designs (n=32), and not studying health professional populations (n=21). Citation searches of eligible studies identified one additional study for inclusion. Nine studies were eligible for inclusion.[11-19]

The characteristics of the nine studies included in the systematic review are outlined in Table 1. Four of the studies were conducted with nurses,[14-16,18,19] four were conducted on trainee physicians,[11-13,17] and one study included nurses, physiotherapists, and midwives.[18] Eight of the nine studies included participants without specific health conditions, while one study focused on participants with chronic lower back pain.[18] Over half of the studies (n=5) focused on early career, newly graduated or trainee health professionals.[11-13,16,17] Majority of participants were employed in large hospital settings,[11-15,17-19] with one study conducted in an academic medical center.[16] The studies were conducted in the USA (n=4),[11,12,16,17] Australia (n=1),[13] Iran (n=1),[14] Spain (n=1),[15] Finland (n=1),[18] and Jordan (n=1).[19] Rates of attrition ranged between none to 22% (mean across all studies = 7.6%). All studies comprised one trial with two arms, apart from Saadat et al. (2012) with three arms[20] and Suni et al. (2018) with four arms.[18] Saadat et al. (2012) included an intervention group and two control groups, whereby one control group received no treatment with time off from duties and the other control group received no treatment and continued routine clinical duties.[17]

Table 1. Characteristics of included RCTs (n=9) examining health behaviour change in health professionals, ordered alphabetically by first author.

Author (year)	Country	Study Stated Aim	Population	Participants	Attrition Rate

Alkhawaldeh et al. (2020)[19]	Jordan	To evaluate the effectiveness of the stress management interventional program in reducing occupational stress and improving coping strategies.	Public health nurses	170	7·6%
Axisa et al. (2019)[13]	Australia	To evaluate the effectiveness of a workshop intervention to promote wellbeing for Australian physician trainees	Physician trainees of RACP	59	22%
Moosavi et al. (2017)[14]	Iran	To determine the effect of a TTM-based intervention on level of physical activity in ICU nurses	Nurses, working in ICU	68	0
Mujika et al. (2014)[15]	Spain	To test the efficacy, acceptability, and feasibility of a motivational interviewing based smoking cessation intervention with nurses.	Nurses, currently smoking	30	0
Saadat et al. (2012)[17]	USA	To evaluate the effects of implementing an evidenced-based, workplace preventive intervention with anesthesiology residents.	Anesthesiology residents	60	3%
Sampson et al. (2019)[16]	USA	To evaluate the effects of MINDBODYSTRONG for Healthcare Professionals Program on stress, anxiety, depressive symptoms, healthy lifestyle behaviors, and job satisfaction.	Nurses, residency program	93	4·3%
Suni et al. (2018)[18]	Finland	To investigate the effectiveness and cost-effectiveness of three intervention-arms (combined neuromuscular exercise and back care counselling or either alone) compared with non-treatment, for improvement of pain, ability to work and fear avoidance related to work/physical activity.	Female health workers with lower back pain (nurses, nurses' aides, specialist nurses, assistant physiotherapists, physiotherapists, & midwives)	219	19·6%
Thorndike et al. (2012)[12]	USA	To test the effectiveness of a nutrition and exercise maintenance intervention to preventing weight regain.	Residents, internal medicine & medicine/pediatric	304	9%
Thorndike et al. (2014)[11]	USA	To test use and access to activity monitor information in a hospital-based physical activity intervention to increase physical activity.	Residents, internal medicine & medicine/pediatric	104	4·8%

ICU = intensive care unit, RACP = Royal Australasian College of Physicians, TTM= transtheoretical model of behavioural change USA = United States of America

The description of interventions and outcomes are outlined in Table 2. Interventions targeted a single or combination of health behaviours. Health behaviours included physical activity (n=4),[11,12,14,18] diet (n=2),[11,12] stress management (n=4),[13,16,17,19] smoking cessation (n=1),[15] and alcohol use (n=1).[13] Techniques to change behaviour included education and instructions on how to perform the health behaviour (n=9),[11-20] demonstration of health behaviours (n=2),[14,18] goal setting (n=4),[12,15,16,19] and environment change (n=2).[11,12] Environment changes included access to an onsite fitness centre along with personal training and staff nutritionist, as well as a catered meal provided weekly at a work seminar[11] or every 3 months in a group seminar[12].

Table 2. Description of health behaviour change interventions and outcomes of included RCTs (n=9), ordered alphabetically by first author.

Authors	Activity Description	Primary Outcomes	Secondary Outcomes	Effectiveness	Quality
Alkhawaldeh et al. (2020)[9]	2 hour sessions on stress, skills in stress management techniques, cognitive change, & behaviours to cope with stress & avoid negative outcomes from stress. Under pinned by Folkman, Lazarus, Dunkel Schetter De Longis, and Gruen's cognitive theory of stress and coping.	Occupational stress via Nurses Stress Scale. Coping strategies via Brief-COPE Scale.	Not applicable	Significant improvement among intervention group compared to control group for total occupational stress scores, total coping strategies scale scores.	Strong
Axisa et al. (2019)[3]	4 hour workshop on wellbeing, health & stress management techniques.	Alcohol use via AUDIT. Depression, anxiety & stress via DASS-21. Secondary traumatic stress & compassion satisfaction via ProQOL.	Not applicable	No significant difference was found between intervention and control.	Weak
Moosavi et al. (2017)[4]	1 hour CBT session for coping mechanisms, benefit of PA, time management for PA, PA strategies. 1 hour practical exercise training session. Isometric exercise CD to be used at home for 30 mins/day.	Physical activity via MET minutes/week questionnaire.	Stages of change (SoC). Self-Efficacy Scale. Decisional Balance Questionnaire Process of change.	Significant improvement among intervention group compared to control group for: MET scores, SOC, POC, Self-efficacy, perceived benefits of PA.	Weak
Mujika et al. (2014)[5]	1 hour session/week of patient centred MI sessions with a therapist to: establish a desire to quit, set a quitting date, maintain abstinence, overcome withdrawal symptoms and adopt a new lifestyle without tobacco.	Smoking cessation verified biochemically via urine cotinine & expired carbon monoxide.	Mean number of cigarettes smoked via self-reporting. Nicotine dependence via FTND. Stages of change via SOCQ. Self-efficacy via general self-efficacy test. Depression via PHQ-9.	Significant improvement among intervention group compared to control group for smoking cessation, mean no. of cigarettes per day, SOC, depression scores.	Moderate
Saadat et al. (2012)[7]	1.5h/week CBT based sessions with 4 components on coping with work & family stress.	Job/family stress via 48 item (RQS) Coping strategies via self-reporting. Social support via an adaption of PSS. Anxiety via STAI. Depression via CESD. Physical symptoms via CHIPS. Alcohol & tobacco use via NSDUH.	Not applicable	Significant improvement among intervention group compared to control group 2 for anxiety score, perceived stress as a parent, coping: problem-solving scores. Significant improvement among intervention compared to both control groups for social support at work.	Moderate
Sampson et al. (2019)[6]	45min/week	Perceived stress via PSS. Anxiety via GAD-7.	Not applicable	Significant improvement among intervention group	Strong

	MINDBODYSTRONG sessions on: caring for the mind, caring for the body, & skills building. CBT concepts to establish weekly goals, & complete skills-building activities weekly.	Depressive symptoms via the 9-item Personal Health Questionnaire. Healthy lifestyle beliefs & healthy lifestyle behaviours via adaption of beliefs scales by Melnyk and colleagues. Job satisfaction via JSS.		compared to control group for perceived stress, anxiety scores, depressive symptoms scores, healthy lifestyle behaviours scores.	
Suni et al. (2018)[8]	1 hour/ 2x per week. First 8 weeks exercise was under instruction, remaining 16 weeks was 1 instructed session 1 at home. A modified Pilates-type exercise programme, started with easier exercises, and was progressive in terms of demands for coordination, balance, and muscular strength over three stages. An additional 10 x 45 min counselling sessions were given exercise + counselling arm. CBT was used for the framework & PBL used to implement counselling sessions.	Intensity of lower back pain measured with the Visual Analog Scale (VAS, 0–100 mm).	Bodily pain interfering with work (via GLMM). FABs related to work/PA (via GLMM). Cost-effectiveness ratio calculated from difference in mean total costs & mean effect (no. sick days or QALYs) between arms.	Significant improvement for only the combined (exercise + counselling) arm in intensity of LBP, pain interfering with work, FABs related to work. Significant improvement for only the exercise-arm in FABs related to PA. Significant improvement for only the combined (exercise + counselling) arm in cost effectiveness.	Strong
Thorndike et al. (2012)[2]	Intervention via website – PA & nutrition goals set weekly (monitored by nutritionist). Website provided resources & journaling option. Every 3 months option for face-to-face nutrition and/or PT session & a lunch-time group seminar.	Weight loss, % weight loss. PA via estimate of intensity level & minutes spent in PA per week during previous 3 months.	Diet via FFQ. BMI, waist circumference, BP, cholesterol, fasting serum glucose.	No significant difference was found between intervention and control.	Moderate
Thorndike et al. (2014)[1]	All participants received 'Be Fit' workplace diet & PA intervention. Intervention group had access to PA monitor & website for tracking steps. Be Fit program included 1/week catered lunch. Access to onsite fitness center & 1 hour PT session/week & 2 nutritionist sessions/week.	PA measured in steps via activity monitor (Fitbit).	Compliance with wearing the monitor.	No significant difference was found between intervention and control.	Moderate

AUDIT = Alcohol Use Disorder Identification Test, BMI = body mass index, BP = blood pressure, CBT = Cognitive behavioural theory, CESD = The Center of Epidemiologic Studies Depression scale, CHIPS = Cohen-Hoberman Inventory of Physical Symptoms, DASS-21 = Depression Anxiety Stress Scale – 21 item, FAB= fear avoidance behaviour , FFQ = food frequency questionnaire, FTND= Fagerström Test for Nicotine Dependence, GAD-7 = Generalized Anxiety Disorder Scale, , GLMM = generalized linear mixed model, , JSS = job satisfaction scale, MET= Metabolic Equivalent of Task scale, , MI = motivational interviewing, NSDUH = National Survey on Drug Use and Health, PA = Physical activity, PBL = problem-based learning, , PHQ-9 = The Patient Health Questionnaire – 9 items, POC = process of change, ProQOL= Professional Quality of Life scale, PSS= perceived stress scale, PT = personal trainer, QALY = quality-adjusted life-year, RQS = role quality scale, SOCQ = stage of change questionnaire, STAI = State-Trait Anxiety Inventory, VAS = visual analog scale.

The intervention components were frequently underpinned by behaviour change theory and the delivery methods varied widely. Behaviour change theories and models used in interventions included: cognitive behavioural theory (n= 4),[14,16-18] transtheoretical/stage of change model (n=2),[14,15] motivational interviewing combined with cognitive dissonance theory (n=1),[15] Pearlin and Schooler's hierarchy of coping mechanisms (n=1),[17] and Folkman and colleagues cognitive theory of stress and coping (n=1).[19] Reporting on how the theory unpinning the interventions varied, with five reporting how the theory was applied to the interventions,[13-16,18] two did not include details on how theory was applied,[17,19] and in two theory was not applied.[11,12] Implementation of interventions was often poorly described including lack of information about delivery tools, resources, and training/qualifications of intervention providers. Two studies[11,15] provided the intervention only through individual sessions, the remaining studies utilised a group setting.

The intensity of sessions and length of interventions varied from 4 to 130 hours over time periods of half a day up to 9 months. The frequency of delivery included one-off sessions (2-4 hours in length) (n=2),[13,14] 1 hour sessions each week (n=3),[15-17] 1 hour sessions twice a week (n=1),[17] and 4 hour sessions 3 times a week (n=1).[19] In person contact with participants varied across interventions with four studies having minimal in person contact following the initial intervention instructions, two had no in person contact until the 6 month follow up[13,14] and two had contact via email or website until follow up[11] or group meeting at three months.[12] Two interventions used technology to contact and prompt participants on physical activity and/or nutrition goals, via monthly email and/or website access.[11,12] Length of time until follow up ranged from no follow up (n=3),[12,14,17] 2 months post intervention (n=1),[19] 3 months post intervention (n=3),[13,15,16] and 6 months post intervention (n=2).[11,18]

The outcome measures varied between the studies. In one study physical activity was measured in steps via an activity monitor,[11] in another study estimated intensity and minutes spent in physical activity per week in the last three months,[12] and in another study the Metabolic Equivalent of the Task (MET) scale through a questionnaire or physical activity per week.[14] In one study, dietary behaviour was assessed via a food frequency questionnaire to estimate the number of serves from major food groups per day during the previous month, and body weight was measured with the percentage of weight loss calculated.[12] In one study, self-reported smoking cessation was confirmed through biochemical measures (urine cotinine and expired carbon monoxide).[15] In one study, changes in lower back pain were measured using the visual analog scale (0 to100mm).[18] Four studies assessed mental health and stress outcomes, using different tools to measure stress, coping, depression and anxiety, which included the Nurses Stress Scale (NSS),[19] the Brief-COPE scale,[19] Perceived Stress Scale (PPS),[16] Professional Quality of Life scale (ProOOL),[13] Job Satisfaction scale (JJS),[16] Generalized Anxiety Disorder Scale (GAD-7),[16] Depression Anxiety Stress Scale (DASS-21),[13] the Center of Epidemiologic Studies Depression scale (CESD),[17] State-Trait Anxiety Inventory (STAI).[17] The two studies that assessed alcohol used the National Survey on Drug Use and Health (NSDUH)[17] survey or an adaption of the Alcohol Use Disorder Identification Test (AUDIT).[13] One study measured cigarette use using the Fagerström Test for Nicotine Dependence, which contains 6 items for quantity, compulsion, and dependence.[15] Finally, one study used the Cohen-Hoberman Inventory of Physical Symptoms

(CHIPS) which uses a 5-point Likert scale to measure the burden of physical symptoms resulting from psychological effects.[17]

Six of the nine studies (n=8 interventions) observed statistically significant outcomes between the intervention and control group.[14-19] Of these, three were wellbeing interventions with mental health and stress-related outcomes,[16,17,19] two were physical activity interventions[14,18] and one was a smoking cessation intervention.[15] Four of the effective interventions were delivered only through education and counselling on health behaviours, one for smoking cessation[15] and three for stress management behaviour.[13,17,19] From a four-armed study, the exercise combined with counselling was more effective at reducing lower back pain than the intervention arms providing only exercise or counselling.[18] One study combined education and instructions to conduct exercises at home for six months and significantly reduced MET scores (intervention 2813.06 (SD 3172.58), control 1196.47 (SD 1441.29), p=0.02).[14]

Of studies that measured readiness or preparation to change behaviour (n=2),[14,15] significant improvement was observed in the intervention groups, with participants progressing from preparation and contemplation stages to action and maintenance.[14,15] In one study, the stage of change for physical activity improved, resulting in 91.2% at the stage of action and 5.9% at the stage of maintenance (p = 0.0001), while the control group remained relatively constant with only 5.9% in the action stage and none in the maintenance stage (p = 0.002).[14] Similar progression in the stages of change occurred in the other study targeting smoking cessation, with the majority of participants in the intervention group progressing to preparation and action stages, 20% and 46% respectively, compared to most participants in the control group remaining in the pre-contemplation and contemplation stages (preparation stage intervention 47% vs control none, p=0.01, action stage intervention 40% vs control 3%, p=0.01).[15]

Of the three wellbeing interventions with a focus on mental health and/or stress management, all reported statistically significant reductions in stress and anxiety.[16,17,19] One study observed lower depressive scores in the intervention group when compared to the control group[16] while another study used two control groups, with one group released from duties (rostered time off) for the duration of the workshop (one hour) while the other group continued routine clinical duties (RD).[17] Statistically significant improvements occurred only between the intervention and the control group not released from duties with lower scores for anxiety (intervention 38.4 vs RD control 45.6, p = 0.02), perceived stress as a parent (intervention 21.7 vs RD control 24.1, p = 0.03), and increased coping scores (intervention 27.7 vs RD control 27.1, p = 0.03).[17] The only effective outcome improved in the intervention group compared to both control groups was perceived social support at work (intervention 27.3 vs RD control 26.7 and rostered time off control 25.5, p = 0.02).[17]

The Effective Public Health Practice Project tool was used to assess the quality of each of the studies, with the summary of ratings presented in Table 3. Of the nine studies, three were rated as strong,[16,18,19] four as moderate,[11,12,15,17] and two as weak.[13,14] The components in which interventions received a low score were study blinding,[11-15,17] not controlling for confounders,[13,14] or selection bias.[15]

Table 3. The Effective Public Health Practiced Project (EPHPP) checklist criteria for each study (n=9).

	Selection Bias	Study Design	Confounders	Blinding	Data collection	Withdrawal and dropout	Overall Rating*
Alkhawaldeh et al. (2020)	Moderate	Strong	Strong	Moderate	Strong	Strong	Strong
Axisa et al. (2019)	Moderate	Strong	Weak	Weak	Strong	Moderate	Weak
Moosavi et al. (2017)	Strong	Moderate	Weak	Weak	Strong	Strong	Weak
Mujika et al. (2014)	Weak	Strong	Moderate	Strong	Strong	Strong	Moderate
Saadat et al. (2012)	Moderate	Moderate	Strong	Weak	Moderate	Strong	Moderate
Sampson et al. (2019)	Strong	Moderate	Strong	Strong	Strong	Strong	Strong
Suni et al. (2018)	Strong	Strong	Strong	Moderate	Strong	Strong	Strong
Thorndike et al. (2014)	Strong	Strong	Strong	Weak	Strong	Strong	Moderate
Thorndikeet al. (2012)	Strong	Strong	Strong	Weak	Strong	Strong	Moderate

*Overall rating based on Strong = 0 weak scores, Moderate = 1 weak score, Weak = ≥ 2 weak scores.

The TIDieR checklist report is shown in Figure 2. Checklist items 2 to 8 were consistently reported on the primary publication for 73% of the included interventions. Checklist items 9 to 11 were not reported across most interventions. These items related to reporting on tailoring, modification, how well planned the interventions were, and how they were implemented. No interventions reported tailoring or modifications, two interventions[11,15] reported intended plans to check how well the intervention delivery adhered to plan, while only one study measured and reported how well the intervention was delivered.[11] Overall, information for 49.5% of 11 of the checklist items (items 2-12) was provided on the primary paper.

Discussion

Summary of evidence

This systematic review has identified a modest collection of heterogeneous studies that show strong promise in enabling improvements in health professionals' personal health behaviours. The professions included trainee physicians, nurses, physiotherapists, and midwives, targeting behaviours related to physical activity, nutrition, stress management, and coping strategies to improve anxiety and depression. Overall, most studies demonstrated significant improvements in health behaviours, which is encouraging and worthy of further investigation through

health workforce policy given the considerable cost related to poor health of health professionals.[6] Despite the heterogeneity of studies, significant progress was found for both direct and indirect behaviour change interventions.

Intervention mode and intensity were keyways that studies were heterogeneous. The most common mode and intensity was in person contact at least once a week. Higher intensity of contact has been shown to increase effectiveness in physical activity interventions.[21] While increased intensity of contact with participants may increase the cost of interventions,[22] a cost effective approach to increase contact has been demonstrated through technology.[23] The use of technology amongst the reviewed studies was limited and the intensity of use was minimal at once a week and/or month,[11] or every three months.[12] Prior studies have noted[21,24] the optimal intensity via technology is between three to five text messages a day[21] and that technology intervention messages require extensive tailoring of content (e.g., to match the stage of change etc.).[21,25] Future interventions should optimise the intensity of contact with participants to enhance intervention outcomes, such as through the use of technology.

Comparison

The included studies involved sessions to raise awareness and/or build knowledge amongst participants. The findings of the review suggest that the effectiveness of interventions was enhanced when counselling or group education workshops were used in combination with activities or approaches which required participants to perform behaviours. This is consistent with previous studies in behaviour change in other populations where effectiveness was enhanced by incorporating factors that aim to promote and support the performance of behaviours and engagement in self-regulation techniques (e.g. goal setting, self-monitoring).[21,26] Future interventions should combine activities that promote action and performance of behaviours to increase the likelihood of change.

Interventions designed for health professionals need to allow for many interacting factors due to differences between work pressures, settings, access to support and resources and these factors increase the complexity of planning and tailoring of interventions to effectively promote behaviour change. The use of theory to underpin interventions can provide a practical means to approach these difficulties and evaluate outcomes.[27] Across the review, studies used a variety of theories and models including the stages of change model,[28] motivational interviewing,[29] and cognitive behavioural therapy.[30] Previous studies have shown that combining theories and approaches has been effective in changing health behaviors.[26] Reporting on how interventions are mapped to the underpinning theory is required to improve reproducibility of successful interventions.[26,31]Including a model to classify progress across interventions may also capture more subtle changes and improve strategies for addressing and/or measuring relapse and maintenance of changes.[32] Behaviour change can be challenging to sustain with some individuals experiencing several relapses when attempting to maintain new health behaviors.[21,26,32] Collectively, the evidence suggests that the use of a combination of theories and approaches, can provide a means to design, implement and evaluate interventions to best meet the specific challenges of the health setting and facilitate sustainable change.

The follow-up activities and duration of studies varied widely. It has been suggested that a key time where individuals are likely to experience behaviour change relapse is in the first six months.[32,33] The reviewed interventions may be failing to capture the patterns of behaviour maintenance and relapse occurring within the first

six months following the intervention. Follow-up is important to establish if the intervention is effective at maintaining behavior change beyond the life of the intervention.[33] Previous studies indicate that a minimum, collection of follow-up data at 6 months post participation is ideal to assess maintenance of behaviour change.[33] Future interventions should follow-up at 12 months and 24 months post program to further increase understanding of program effectiveness.[33,34]

Limitations

This review has highlighted a number of gaps which may be addressed in future research. The reviewed interventions were focused on a limited number or specific professional groups. Extending inclusion of intervention activities to a diverse group of health professions may increase social support and promote greater team connectedness.[21,35] Dietary behaviour was only addressed in one intervention, and as diet has a significant influence on health, interventions to support healthy dietary behaviours may be worthy of being prioritised. Evaluation of cost effectiveness was also limited. Comparing intervention cost to improvement in quality of life and reduced staff turnover and absenteeism can make interventions more likely to be worthy of implementation. Factors which support action such as social support are important areas to be addressed to improve the effectiveness of interventions.[21] Overall, the progress achieved across a variety of behaviours is promising and key gaps have been highlighted, although determining the future direction for interventions for health professionals may be challenging.

To advance the evidence consistent reporting methods with consensus on ideal outcomes for tracking specific health behaviours are needed. Improving the reporting of behaviour change strategies, their associated theories and models, and their outcomes will enhance future intervention design. Additionally, integrating monitoring and evaluation measures into intervention design including measures of behaviour maintenance and intervention cost effectiveness will provide a strong evidence base on which to develop future interventions.

Contributorship

JH, JC, KB, LM and LB accessed and verified the study data. LB conceived and designed the review. JH analysed the data and interpreted the data. JH wrote the first draft of the manuscript with input from JC, KB and JP. All authors critically revised the manuscript for intellectual content. LB and JP supervised the study. All authors had access to data and had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

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Declaration of interests

We have read and understood the BMJ policy on declaration of interests and declare the following interests: None.

Ethics approval

Existing publications were reviewed for this research therefore, no ethics applications were needed.

Data sharing

Data can be requested from the corresponding author.

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Figure 1. PRISMA flowchart of study selection.

Figure 2. Percentage of RCT (n=9) with adequate TIDieR items (2-12) reported in the original study, additional sources or not reported.

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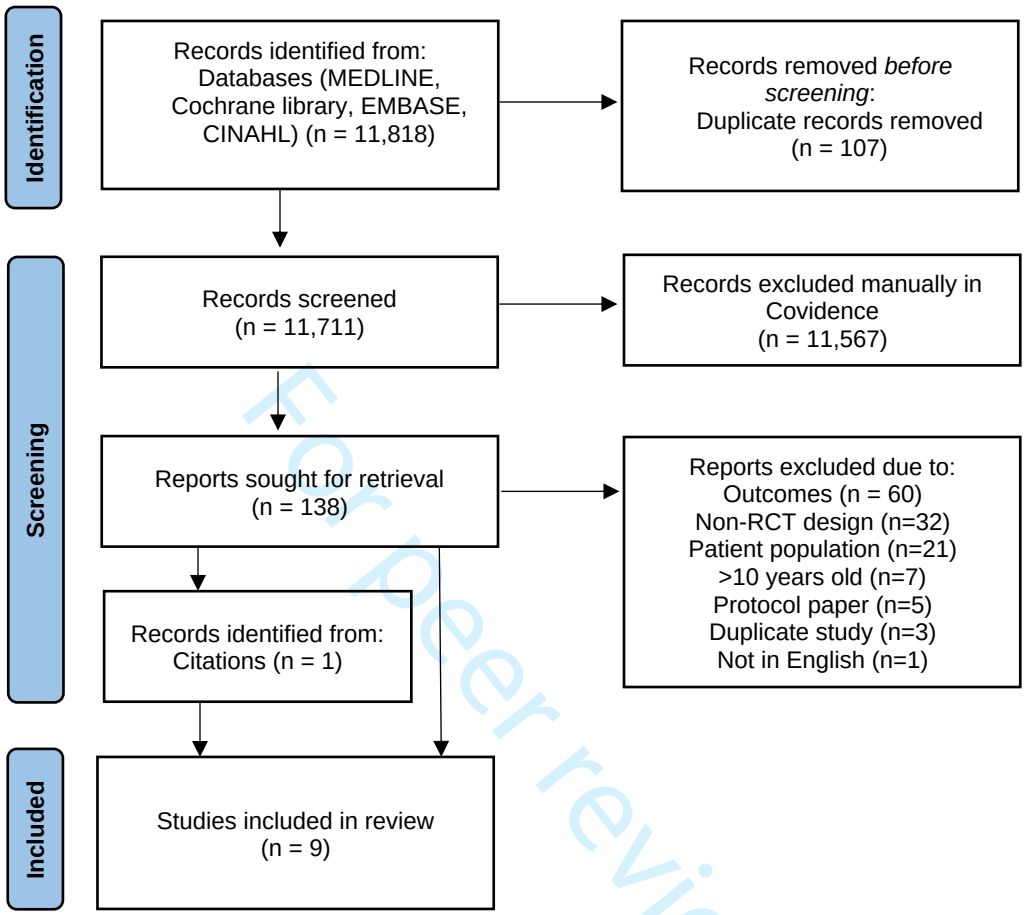

Figure 1. PRISMA flowchart of study selection.

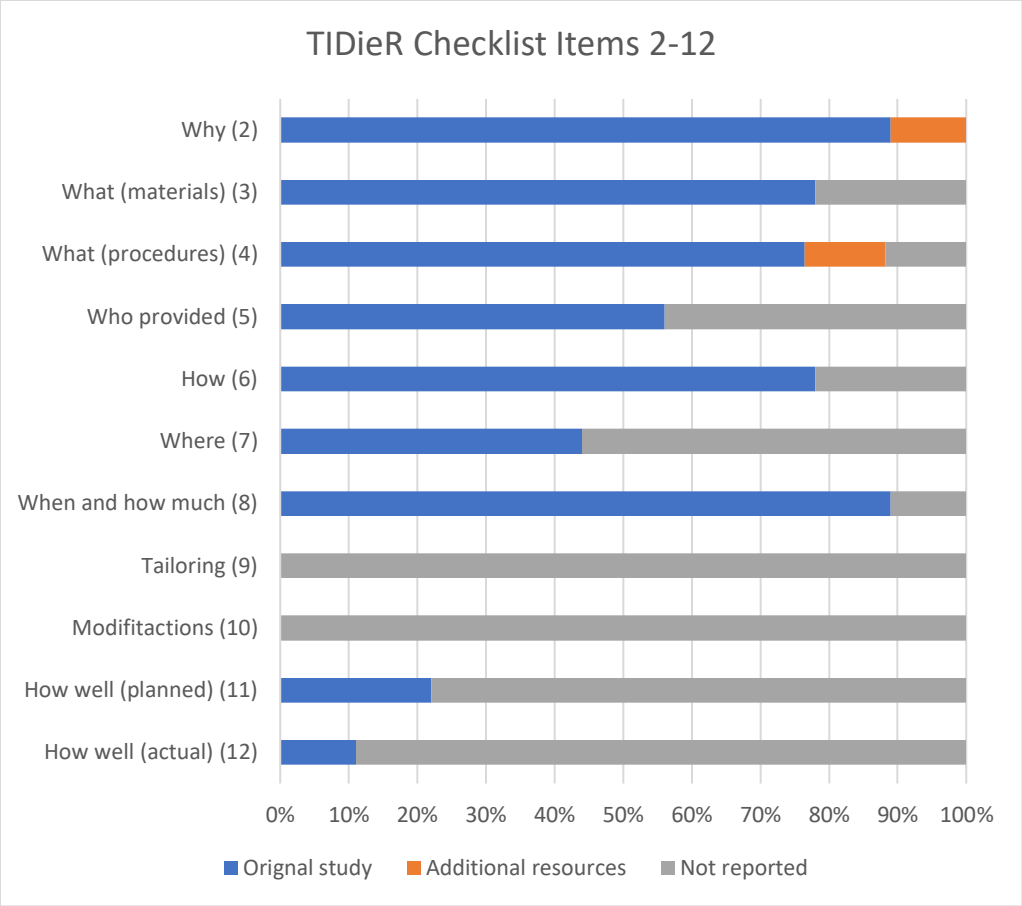

Figure 2. Percentage of RCT (n=9) with adequate TIDieR items (2-12) reported in the original study, additional sources or not reported.

Supplementary material

Appendix 1

Searches: The following electronic databases will be searched (MEDLINE, Cochrane library, EMBASE, CINAHL). Boolean connectors AND will be used to combine three search categories related to (i) health professionals/students, (ii) intervention and (iii) specific intervention details. Boolean connectors OR will be used to combine search terms within each category.

I. Search terms related to health professionals include: “health professional*” OR resident* OR consultant* OR registrar* OR “healthcare professional*” OR “health student*” OR “healthcare student*” OR “healthcare worker*” OR “health clinician*” OR “healthcare clinician*” OR nurse* OR “student nurse*” OR “nurse student*” OR “nurse professional*” OR doctor* OR “student doctor*” OR “doctor student*” OR “medical professional*” OR “medical student*” OR “general practitioner*” OR dietitian* OR dietician* OR “dietician student*” OR “dietitian student*” OR “student dietitian*” OR “student dietician*” OR “dietetic student*” OR nutritionist* OR “nutrition student*” OR “student nutritionist*” OR pharmacist* OR “student pharmacist*” OR “pharmacy student*” OR physiotherapist* OR “physiotherapy student*” OR “student physiotherapist*” OR psychologist* OR “psychology student*” OR “student psychologist*” OR “occupational therapist*” OR “student occupational therapist*” OR (MH "Nurses") OR (MH "Nurses, Public Health") OR (MH "Nurses, Male") OR (MH "Nurses, International") OR (MH "Nurses, Community Health") OR (MH "Nurse Specialists") OR (MH "Nurses, Pediatric") OR (MH "Nurse Midwives") OR (MH "Nurse Clinicians") OR (MH "Nurse Anesthetists") OR (MH "Nurse Practitioners") OR (MH "Pediatric Nurse Practitioners") OR (MH "Family Nurse Practitioners") OR (MH "Nursing+") OR (MH "Physicians") OR (MH "Urologists") OR (MH "Radiologists") OR (MH "Surgeons+") OR (MH "Oncologists+") OR (MH "Neurologists") OR (MH "Nephrologists") OR (MH "Geriatricians") OR (MH "General Practitioners") OR (MH "Gastroenterologists") OR (MH "Endocrinologists") OR (MH "Dermatologists") OR (MH "Cardiologists") OR (MH "Anesthesiologists") OR (MH "Allergists") OR (MH "Pharmacists") OR (MH "Occupational Therapists") OR (MH "Nutritionists") OR (MH "Anesthetists+") (MH "Medical Staff+") OR (MH "Nursing Staff+") OR (MH "Physical Therapists") OR (MH "Students, Medical") OR (MH "Students, Pharmacy") OR (MH "Students, Nursing")

i. Search terms related to the intervention include: “randomized controlled trial” OR (MH "Randomized Controlled Trial") OR “controlled clinical trial” OR randomized OR randomised OR randomly OR “pre-post”

ii. Search terms related to the specific intervention details include: “physical activity” OR exercise OR fitness OR nutrition OR “eating habits” OR “dietary habits” OR “food intake” OR “dietary intake” OR “dietary change” OR “healthy eating” OR “dietary behavior” OR “dietary behaviour” OR eating OR smoking OR “smoking cessation” OR “quitting smoking” OR “quit smoking” OR alcohol OR (MH "Exercise+") OR

(MH “Healthy Lifestyle+”) OR (MH "Smoking Cessation") OR (MH "Smoking+") OR (MH "Smoking Reduction") OR (MH “Alcohol Drinking+”)

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	pg 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Pg 1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Pg 1-2
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Pg 2
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Pg 2
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Pg 2
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Pg 2
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Pg 2
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Pg 2
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Pg 2-3
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Pg 3
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Pg 3
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Pg 3
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	na
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	na
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	na
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	na
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	na
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	na
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Pg 3
Certainty	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	na

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
assessment			
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Pg 4
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Pg 4
Study characteristics	17	Cite each included study and present its characteristics.	Pg 5
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Pg 12
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Pg 5 - 12
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	na
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	na
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Pg 5-12
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	na
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Pg 12
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	na
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Pg 13
	23b	Discuss any limitations of the evidence included in the review.	Pg 14
	23c	Discuss any limitations of the review processes used.	Pg 14
	23d	Discuss implications of the results for practice, policy, and future research.	Pg 14
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Pg 1
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Pg 1
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	na
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Pg 1 & 4
Competing interests	26	Declare any competing interests of review authors.	Pg 3 & 14
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Request to corresponding author

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PRISMA 2020 Checklist

10.1136/bmj.n71

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