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The effect of physical activity interventions on occupational stress for health personnel: A systematic review

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ABSTRACT

Background: High occupational stress and its implications on health in people who are working in the healthcare sector are well-documented. However, less is known about beneficial effects physical activity interventions might have on occupational stress in healthcare settings.
Objective: This systematic review aims to identify the current evidence on the effect of physical activity interventions on stress outcomes in health personnel.
Design: A systematic review with quality assessment.
Method: PsycINFO, Medline and CINAHL databases were searched in February 2018 using a combination of synonyms of the terms “health personnel”, “physical activity” and “occupational stress”. The search was repeated in March 2019.
Results: N = 18 experimental studies were included, representing three specified physical activity intervention types (yoga, tai chi and qigong) and different non-specific worksite training programs. Nine studies conducted a multi component intervention with a minor part being physical activity. A total of *n* = 9 studies investigated the effect of a single component physical activity intervention on stress (seven RCTs, two pre-post intervention studies). Stress measurements used were heterogeneous and only five studies specifically assessed occupational stress. None of the nine studies were considered to be of high quality. All of the included studies scored lower than seven (out of a maximum quality score of 14) with risks of performance and attrition bias. Results suggest a stress reducing effect of yoga and qigong interventions, whereas general workplace physical activity programs and tai chi did not show significant effects.
Conclusions: The present review indicates that yoga and qigong might be an effective way of reducing stress in health personnel and could be incorporated into health promotion in the healthcare sector. Nevertheless, further research with appropriate planning and detailed descriptions of the conducted interventions (duration, frequency and intensity) is needed to determine the effect of physical activity interventions on occupational stress.

What is already known about the topic?

- Occupational stress is exceptionally high in employees of the healthcare sector.
- Stress in health personnel is associated with many chronic diseases, health impairing behaviors as well as staff turnover and medical errors.
- Physical activity is being discussed on having a stress reducing or regulating effect.

What this paper adds

- No systematic review on the effect of physical activity interventions on health personnel has been published yet.
- This paper identifies physical activity intervention studies aimed at reducing stress in employees of the healthcare sector.
- Limited evidence is available on the effectiveness of physical activity interventions in reducing health personnel’s stress. Studies especially lack adequate descriptions of the type of physical activity as well as duration and intensity of the conducted interventions.
- Yoga and qigong are potentially effective in reducing stress in health personnel.
- Further studies are needed which incorporate appropriate planning, measurement and description of physical activity.

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1. Introduction

The workplace has received much attention in the past decades as it is seen as a key determinant of various health outcomes (Hofmann et al., 2017). Furthermore, public health has focused attention on health issues related to work stress since chronic stress has been shown to contribute to the etiology of many diseases such as elevated blood-pressure, chronic colonic inflammation and mental disorders (Bhatia and Tandon, 2005; Kivimäki et al., 2013; Landsbergis et al., 2013; Stansfeld and Candy, 2006).

Comparing different professions, health personnel report exceptionally high amounts of stress. Numerous organizational and behavioral studies have assessed the specific stressors in health personnel (Hasson and Arnetz, 2008; Jacobsen et al., 2014; Muncer et al., 2001; Nübling et al., 2010; Sehlen et al., 2009; Weinberg and Creed, 2000). For instance, McVicar conducted a systematic review on workplace stress in nurses and found workload, leadership style, professional conflict, emotional cost of caring as well as lack of reward and shift working to be the main sources of occupational stress (McVicar, 2003). Spooner-Lane (2004) found an association between work stress and burnout in Australian nurses with work-stressors being the main predictors of emotional exhaustion. High stress levels and burnout in nurses lead to absenteeism and nursing turnover resulting in staff shortages and further work intensification (Bridger et al., 2013). Physicians report high quantitative demands (the amount and pace of work), perceived increasing responsibility towards patients, role uncertainty, personal costs, their relationship with colleagues and staff, and medical bureaucracy as main sources for occupational stress (Bernburg et al., 2016; Pedrazza et al., 2016). Radical changes associated with the need of being profitable and meeting upcoming demands of demographic changes as well as digitalization are increasing further pressure on the healthcare sector and induce additional burden on its staff (Abramovitz and Zelnick, 2010; Farquharson et al., 2013; Maresso et al., 2015). The rising health expectancy leads to the prediction that 11.6% of the total global population will be over 65 years old in 2022, which will result in an global increase in health care demands (Deloitte, 2018). Furthermore, the downsizing of hospital services, an emphasis on outpatient treatment and staff shortages are structural sources of high demands and act as additional chronic psychosocial risk factors on the remaining employees (Aiken et al., 2002).

Health personnel are therefore exceptionally prone to the effects of stress. Staff providing health services is susceptible to dissatisfaction, burnout, compassion fatigue, diminished quality of life, substance abuse, and even suicide (Michie and Williams, 2003; Sallon et al., 2017). Rieger et al. (2014) examined the effect of intraoperative stress on the cardiovascular system in surgeons and concluded that some of their study participants were at a significantly higher risk for cardiovascular events. Furthermore, stress is associated with health-impairing behaviors such as higher fast food consumption, infrequent exercise, higher alcohol consumption and more frequent painkiller use (Alexandrova-Karamanova et al., 2016). For health personnel, an adequate reaction to high stress levels is especially important in regard of their own health and well-being but also as a potential factor leading to medical errors and inadequate patient care (Poghosyan et al., 2010). For instance, research shows that nurse burnout is associated with patient infections, patient and family complaints, patient falls, medication errors and lower patient safety (Hall et al., 2016; van Bogaert et al., 2014). Consequently, the need for effective interventions to reduce stress of health personnel is urgent.

The high psychosocial demands in the healthcare sector should be addressed on a structural level through policy changes. Until these changes take place, behavioral prevention needs to be established in order to help health personnel cope with existing stressors. One possible solution might be physical activity: The benefits of regular physical activity on general health and especially on life-style associated health problems such as obesity, cardiovascular diseases and diabetes are well-researched (Lear et al., 2017; Sarma et al., 2015). However, whether these physical benefits can translate to improvement in perceived psychosocial outcomes remains inconclusive. Growing evidence suggests that self-reported physical activity is inversely related to perceived stress (Avila-Palencia et al., 2017; Lippke et al., 2015; Nguyen-Michel et al., 2006; Wijndaele et al., 2007). Furthermore, physical activity is being discussed to have a regulating effect on stress and stress reactivity (Gerber and Pühse, 2009; von Haaren et al., 2016; Klaperski et al., 2014). The so-called 'cross stressor adaptation hypothesis' is based on the finding that exercise and acute psychosocial stressors share similar effects on the neuroendocrine system (Hackney, 2006). Regular exercise leads to higher cardiovascular fitness levels and, potentially as an indirect consequence, to a more efficient physiological way of regulating stress reactions (concerning the hypothalamic-pituitary-adrenal (HPA) axis as well as the autonomic nervous system reactivity) (Hackney, 2006; Rimmele et al., 2009; Spalding et al., 2004). On the other hand, studies fail to duplicate these results (Gerber and Pühse, 2008; Gnam et al., 2018; Jayasinghe et al., 2016; Lindgren et al., 2013; Sloan et al., 2011). Heterogeneous findings may be due to different applied stressors as well as a variety of stress reactivity parameters such as heart rate, blood pressure, heart rate variability, cortisol, adrenaline or alpha amylase.

In general, physical activity may influence the stress-health relationship through different pathways. Gerber and Pühse (2009) discuss four possible mechanisms of exercise on stress and health in addition to the mentioned cross stressor adaptation hypothesis. According to them a preventive effect may also occur due to (1) a lowered psychological stress appraisal, (2) the strengthening of other personal (i.e. self-esteem) and social resources (i.e. social support), (3) the protection of stress induced losses of personal and social resources. The fourth (4) possible pathway is specific to times of heightened stress and is called the 'stress buffering effect'. In accordance with the latter are Smits et al. (2011) findings, who reported that physical activity's protective effects may be specific to those at elevated risk for psychological disorders.

According to the most common stress model, the transactional theory, a stress response is triggered when an individual appraises a situation as challenging (Lazarus and Folkman, 1987). Studies show that regular exercise can lead to a reduced perception of stress (Asztalos et al., 2009; Avila-Palencia et al., 2017; Yorks et al., 2017).

Little is known about the transferability and congruency of the discussed associations and possible pathways between physical activity and stress in an occupational context in the healthcare setting.

Jonsdottir et al. (2010) explored the relationship between self-reported physical activity and perceived level of stress in a large survey in a study population of mainly health personnel. Their surveys results showed that health personnel who reported light as well as moderate to vigorous physical activity were less likely to perceive high stress levels. The same data was calculated in a latent profile analysis and showed that being physically inactive was a risk factor for being classified in the profiles "highly burdened" or "stressed" (Gerber et al., 2014). Besides, Yao et al. (2008) found a similar relationship in female nurses, when in his study the physical activity level of the past seven days was related to nursing stress scores. These few cross-sectional studies suggest a similar protective effect of physical activity on stress in the population of health personnel as in other professions. These studies used stress measurements which were not necessarily specific to stress perceived at the workplace ('occupational stress') but rather assessed general perceived stress. In this context, a general stress reducing effect of physical activity is assumed to be reducing occupational stress as well. Nevertheless, cross sectional study designs incorporate methodological limitations, since they are not able to investigate cause-effect associations.

Since the stress levels in the healthcare sector are especially high and benefits of regular physical activity on general health are well documented and an effect on mental health is assumed, the aim of this study is to systematically review research investigating the effect of physical activity on occupational stress in health personnel in longitudinal intervention studies.

The specific review questions to be addressed are: Do physical activity interventions reduce occupational stress in health personnel? And: Which type of physical activity intervention, at what duration and frequency (time) and intensity (absolute and relative) can reduce stress in health personnel?

The primary outcome is stress regardless of what measurement was used (objective or subjective). Questionnaires such as the Perceived Stress Scale are included even though they do not specifically assess occupational stress but general stress. In accordance with study findings that declare work stressors as the main predictors of burnout, measures such as the Maslach Burnout Inventory were also accepted as stress outcome (Khamisa et al., 2016; Spooner-Lane, 2004).

2. Methods

This systematic review was registered in Prospero (registration number: CRD42018085913). Furthermore, it was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standard (Moher et al., 2009).

2.1. Literature search and retrieval

PsycINFO, Medline and CINAHL databases were searched in a first step using a combination of synonyms of the terms “health personnel”, “physical activity” and “occupational stress”. Searches were conducted using MeSH terms, keywords, and free text words depending on the database and were performed in February 2018 (for more details see Appendix Table 1). Limiting filters used were English and German language as well as human studies. The search was repeated in March 2019 using the exact same search terms.

A second step was a manual search of additional relevant source materials that may have been missed in the database search. The manual search included a screening for relevant studies within the reference lists of the retrieved articles and in potentially relevant journals as well as a non-systematic search in Google Scholar.

All records identified were exported to Citavi reference database. Duplicates were then removed automatically by the software. The remaining studies were reviewed independently by two authors (LLB and AKO) with regard to inclusion criteria and later on with regard to potential risk of bias. Disagreements between the review authors over inclusion criteria or risk of bias in particular studies were resolved by discussion, with the involvement of a third review author (CH). They were scanned for risk of bias using the Updated Method Guidelines for Systematic Reviews in the Cochrane Back and Neck Group (Furlan et al., 2015) with the addition of the criteria of appropriate description of the intervention (content, intensity, duration) as suggested by Wollesen and Voelcker-Rehage (2014).

2.2. Eligibility criteria

This review considered longitudinal intervention studies examining the effect that physical activity or training interventions have on occupational stress in health personnel providing health services, practicing in hospitals, nursing homes, rehabilitation centers or other facilities, regardless of gender or ethnicity. Health personnel are understood in relation to the MeSH definition as “men and women working in the provision of health services, whether as individual practitioners or employees of health institutions and programs, whether or not professionally trained, and whether or not subject to public regulation.”

Studies that incorporated physical activity in a multi component intervention were included, but are to be viewed separately to single component physical activity interventions. In this context, physical activity is defined as any voluntary bodily movement produced by skeletal muscles that results in energy expenditure including concepts of exercise and sports (Caspersen et al., 1985).

Longitudinal studies were eligible regardless of whether they compared the intervention to another intervention or a control group or when they did not utilize a comparator at all. Furthermore, all measures assessing the primary outcome stress (objective or subjective) were included.

Not taken into account were grey literature, unpublished doctoral dissertations and studies focusing on health personnel in training or medical students.

Studies were classified with regard to multi component and single component interventions. Intervention studies that evaluated the effect of single component physical activity interventions were then assessed in terms of study quality.

3. Results

The search yielded a total of 1257 studies, 90 in PsycINFO, 458 in Medline and 709 in CINAHL. The manual search added one further study (Griffith et al., 2008). All titles and abstracts were screened and 50 full texts were assessed for eligibility criteria, resulting in n = 17 included studies (see Flow Chart in Fig. 1). The remaining *n* = 33 were excluded for the following reasons:

24 incorporated no physical activity in the intervention (Alexander, 2013; Asuero et al., 2014; Bair and Greenspan, 1986; Blake and Gartshore, 2016; Blake and Lee, 2007; Bolden et al., 2011; Brennan and McGrady, 2015; Cronin-Stubbs and Pencak, 1989; Davis et al., 2005; Duncan et al., 2011; Hope et al., 1998; von Känel et al., 2011; Lahn, 2015; Lindwall et al., 2014; Low et al., 2015; Malinauskiene et al., 2011; Otto, 2009; Repar and Patton, 2007; Tang et al., 2010; Thomas et al., 2017; Umann et al., 2014; Wald et al., 2016; Yamagishi et al., 2007; Zimber et al., 2001), five included occupations outside of the healthcare sector or health personnel in training (Blair et al., 1998; Coleman, 2011; Martin and Keats, 2014; Mason, 2001; Waelde et al., 2004), three did not assess stress as an outcome (Klatt et al., 2015; Lagerstrom and Hagberg, 1997; Szeto et al., 2010) and one (Steinberg et al., 2016) used data from the same sample and intervention as another study already included (Duchemin et al., 2015).

The search was repeated by LLB and AKO in March 2019. One additional multi component intervention study could be identified in Medline that fit the eligibility criteria (Wright, 2018), resulting in a total of N = 18 included studies.

3.1. Description of included studies

Included studies were classified in an overview table in the appendix differentiating between single component and multi component interventions, with mindfulness-based interventions defined as multi component interventions.

Sample sizes ranged from 9 (Anderson et al., 2017) up to 282 (Horneij et al., 2001) participants, with a mean sample size of 71,1 $\pm$ 5,4 out of the 18 included studies. The majority of the studies (n = 7 studies) examined nurses, two studies focused on intensive

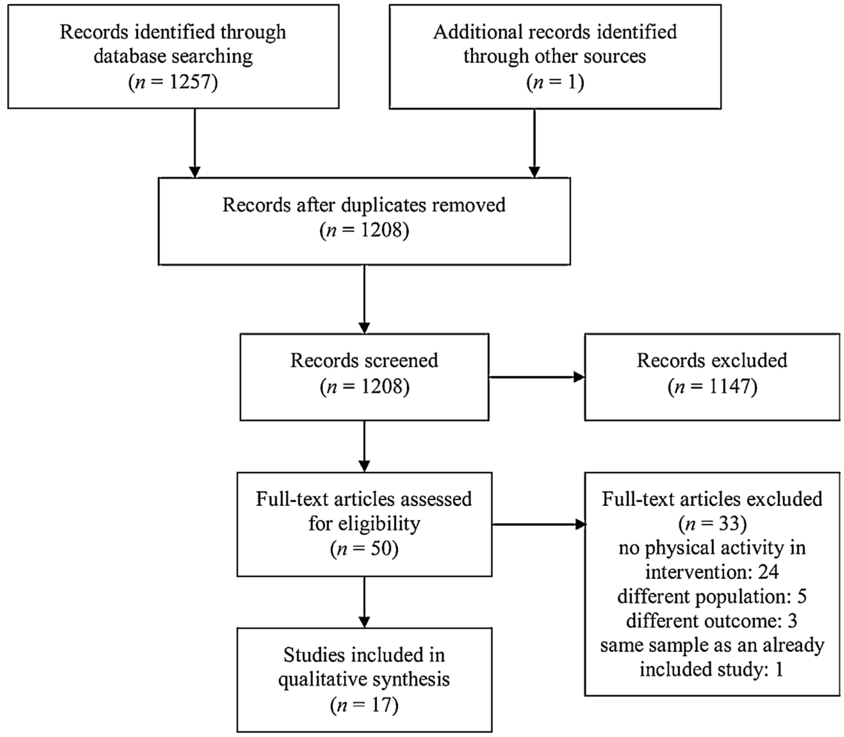

Fig. 1. Systematic literature search scheme in February 2018.

care unit personnel (Duchemin et al., 2015; Mealer et al., 2014), one on registered nurses of an inpatient psychiatric unit (Anderson et al., 2017), one on mental health professionals (Lin et al., 2015), one on female nursing aides and assistant nurses working in the homecare service for elderly or handicapped people (Horneij et al., 2001) one on employees of hospitals without further specifying job titles (Griffith et al., 2008) and one on employees within the home care service in a specific Swedish district (Gerdle et al., 1995). The rest of the studies defined their population as "health professionals" (Martín-Asuero and García-Banda, 2010; Tarantino et al., 2013) or "healthcare workers" (Tveito and Eriksen, 2009). The large majority of the sample (78%–100% of each study's participants) was female. The highest percentage of male participants was examined by Griffith et al. (2008) with 11 male employees of a Medical Center. The studies' participant's age ranged around 24–59 years.

Most of the included studies were conducted in the United States of America, two in Sweden (Gerdle et al., 1995; Horneij et al., 2001) one in China (Fang and Li, 2015), Brazil (Freitas et al., 2014), Taiwan (Lin et al., 2015), Canada (Lavoie-Tremblay et al., 2014), Spain (Martín-Asuero and García-Banda, 2010), Israel (Tarantino et al., 2013) and Norway (Tveito and Eriksen, 2009).

3.2. Types of physical activity

A total of $n = 9$ studies investigated the effect of a single component physical activity on occupational stress (seven RCTs, two pre-post intervention studies). Nine studies explored the effect of multi component interventions, with two studies incorporating exercise as part of a mindfulness-based program (Duchemin et al., 2015; Martín-Asuero and García-Banda, 2010).

In total, nine out of 18 studies used at least one of multiple varieties of yoga practices as part of the intervention program (Alexander et al., 2015; Anderson et al., 2017; Duchemin et al., 2015; Fang and Li, 2015; Lin et al., 2015; Martín-Asuero and García-Banda, 2010; Sallon et al., 2017; Tarantino et al., 2013; Wright, 2018). Three studies integrated endurance training in single component or multi component stress reduction programs (Gerdle et al., 1995; Horneij et al., 2001; Mealer et al., 2014). Explicit strength training exercises were included in one program (Gerdle et al., 1995). Three studies asked participants to perform an unsupervised training program (Horneij et al., 2001; Johnson et al., 2015; Mealer et al., 2014). Other types of exercise interventions used were medical qigong (Griffith et al., 2008), Yang style tai chi (Palumbo et al., 2012), a pedometer activity challenge (Lavoie-Tremblay et al., 2014), standardized aerobic dancing (Tveito and Eriksen, 2009) and a web-based stress reduction training including yoga poses (Wright, 2018).

3.3. Duration, frequency and intensity of physical activity

Out of the single component physical activity interventions, the duration of the interventions ranged from six weeks (Anderson et al., 2017; Griffith et al., 2008) to one year (Gerdle et al., 1995). One study did not specifically state the duration of their individual physical training program, but it is assumable it lasted for six months (Horneij et al., 2001).

Because of inadequate descriptions of frequencies the total hours study participants spent physically active in the intervention could only be calculated for six studies (Anderson et al., 2017; Freitas et al., 2014; Gerdle et al., 1995; Griffith et al., 2008; Lin et al., 2015; Palumbo et al., 2012), ranging from nine hours (Anderson et al., 2017) to approximately 106 h (Gerdle et al., 1995).

Only two studies provided information about intensities of applied exercises (Gerdle et al., 1995; Griffith et al., 2008; Horneij et al., 2001): Gerdle et al. (1995) tested the effect of a one year physical exercise intervention on occupational stress. Participants took part in a standardized one hour training program twice a week that included warming up movements, exercises of coordination and general strength exercises. Endurance training was realized via two or three intervals aiming at an increase in heart rate to about 120. As intensities are to be specified relative to individual fitness levels (in relation to maximal heart rate or better yet maximal oxygen consumption), these details only provide a rough estimation of the intensity the participants trained at. Horneij et al. (2001) evaluated the effect of an individual physical training program on perceived work-related psychosocial factors, incorporating exercises according to participants' individually defined goals. The intensity was vaguely assessed via a diary in which participants had to make a note every time they exercised for cardiovascular fitness for more than 20 min and perceived the training as "somewhat hard".

None of the included single component studies controlled for physiological adaptation (e.g. via maximal oxygen uptake (VO_2max)) or measured physical activity.

The interventions were mostly performed in a team-based manner. Only one program was designed as individual training sessions (Horneij et al., 2001). Freitas et al. (2014) did not describe whether they used a group-based or individual training approach. Furthermore, most of the included single component studies did not provide information on the implementation and setting specifics, for example whether training sessions were performed during working hours. Only Anderson et al. (2017) as well as Griffith et al. (2008) stated that they performed the yoga and qigong courses respectively within the workplace during regular working hours.

3.4. Stress measures

The majority of the studies assessed stress via validated measures. Two studies used self-generated questionnaires (Anderson et al., 2017; Gerdle et al., 1995). Stress was mostly measured on the basis of the transactional theory (Duchemin et al., 2015; Fang and Li, 2015; Griffith et al., 2008; Johnson et al., 2015; Martín-Asuero and García-Banda, 2010; Palumbo et al., 2012; Sallon et al., 2017; Wright, 2018) and all studies solely assessed chronic stress, none acute stress or acute stress reactivity.

The Perceived Stress Scale (PSS) (Duchemin et al., 2015; Griffith et al., 2008; Johnson et al., 2015; Lavoie-Tremblay et al., 2014; Martín-Asuero and García-Banda, 2010; Palumbo et al., 2012; Sallon et al., 2017; Tarantino et al., 2013; Wright, 2018) and the Maslach Burnout Inventory (MBI) (Alexander et al., 2015; Freitas et al., 2014; Mealer et al., 2014; Sallon et al., 2017) were mostly used as a stress assessment. These instruments are notably not specific to occupational stress. Occupational stress was assessed by five studies via a variety of validated questionnaires such as the Chinese version of the Questionnaire on Medical Workers' Stress (QMWS) (Fang and Li, 2015), the Portuguese version of the Job Stress Scale (JSS) (Freitas et al., 2014), the Chinese version of the Work-Related Stress Scale (Lin et al., 2015), the Nursing Stress Scale (NSS) (Palumbo et al., 2012) or the Job Related Tension Index (JRTI) (Sallon et al., 2017) and two studies used single dimensions out of validated questionnaires (Horneij et al., 2001; Tveito and Eriksen, 2009), focusing on the individual's psychological responses to work environmental demands, threats and challenges and therefore on the subjective perspective.

One study assessed the physiological response to work environmental demands, threats, and challenges via the heart rate variability (HRV) as an objective measure (Lin et al., 2015).

All included studies were summarized in order to give an overview of existing stress intervention studies incorporating physical activity in health personnel in Appendix Table 2.

With a view to identifying the effects of physical activity on stress in the healthcare setting as well as the appropriate volume of exercise, a clear distinction between multi component and single component intervention designs is necessary. The effects of multi component interventions cannot be solely explained by effects of physical activity and recommendations for the type, duration and intensity of the physical activity interventions cannot be drawn up. Therefore, the following results refer to $n = 9$ single component physical activity interventions.

3.5. Risk of bias in included studies

Seven (Alexander et al., 2015; Fang and Li, 2015; Gerdle et al., 1995; Griffith et al., 2008; Horneij et al., 2001; Lin et al., 2015; Palumbo et al., 2012) of the nine single component intervention studies in this review were randomized controlled trials (RCT). The quality of the studies was assessed using the Updated Method Guidelines for Systematic Reviews in the Cochrane Back and Neck Group (Furlan et al., 2015). The interobserver reliability of the risk of bias assessment was calculated using Cohen's kappa and showed an almost perfect agreement among raters LLB and AKO (K = 0.92) (McHugh, 2012).

None of the nine studies were considered to be of high quality. All of the included studies scored lower than seven (out of a maximum quality score of 14) with risks of performance and attrition bias. Reasons for low ratings mainly were: non-blinded participants care provider and outcome assessor, not adequately described or not acceptable drop-out rates, non-similar groups at baseline and unacceptable compliance, lack of intention to treat-analyses as well as inadequate descriptions of the intervention.

Low ratings in the "other sources of potential bias" criterion were caused by low sample sizes. Overall, the risk of bias scores across all criteria were mostly "unsure". The studies by Horneij et al. and Lin et al. scored the highest with a quality score of six (see Table 1).

3.6. Effects of single component physical activity interventions on occupational stress

Four of the single component physical activity interventions resulted in lowered perceived stress levels in health personnel (Alexander et al., 2015; Fang and Li, 2015; Griffith et al., 2008; Lin et al., 2015). Three of these four studies used yoga as a physical activity intervention. Two studies described the duration and frequency of the interventions: Griffith et al. (2008) found a reduction in the Perceived Stress Scale scores in the group of hospital employees that practiced a total of 12 h of qigong (six weeks, one hour twice a week) and this change was significantly different compared to the wait list control group. Lin et al. (2015) showed significant improvements in the work-related stress scores and stress adaptation scores after a total of 12 h of yoga (12 weeks, one hour a week) in mental health professionals in a teaching hospital. Compared to the control group, the work-related stress scores of the yoga group significantly decreased but those changes were not significant in comparison to the control group regarding the stress adaptation scores. Furthermore, Lin et al. measured the effect of the 12 week yoga intervention on heart rate variability (HRV). Neither the difference in the low-frequency band of heart rate variability nor the difference in the high-frequency band of heart rate variability (which is a good indicator of the parasympathetic nerve function) was significant between the groups post intervention.

Five studies showed no significant effect of the single component physical activity interventions on stress in health personnel (Anderson et al., 2017; Freitas et al., 2014; Gerdle et al., 1995; Horneij et al., 2001; Palumbo et al., 2012). These studies used workplace physical activity programs, an individually designed home training program, yoga nidra and tai chi as interventions. Four studies described duration and frequency of the intervention with a total of hours spent at the intervention ranging from nine hours of yoga nidra (Anderson et al., 2017) to approximately 106 h of a workplace physical activity program (Gerdle et al., 1995). The

Table 1
Quality scores of the included studies and remarks.

study	quality criteria (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	quality score	remark
Alexander et al., 2015	(x)	(x)	–	–	–	–	(x)	x	x	(x)	(x)	(x)	–	x	**3**	(3): participants are not blinded (index and control group are distinguishable), (4): care provider is not blinded (index and control group are distinguishable), (5): outcome assessor (self report) not blinded, (6): drop-out rate not adequately described, (13): exercises not adequately described
Fang and Li, 2015	x	(x)	–	–	–	(x)	x	x	x	(x)	(x)	(x)	–	x	**5**	(3): participants are not blinded (index and control group are distinguishable), (4): care provider is not blinded (index and control group are distinguishable), (5): outcome assessor (self report) not blinded, (13): exercises not adequately described
Gerdle et al., 1995	(x)	(x)	–	–	–	–	(x)	x	–	(x)	–	(x)	x	x	**3**	(3): participants are not blinded (index and control group are distinguishable), (4): care provider is not blinded (index and control group are distinguishable), (5): outcome assessor (self report) not blinded, (6): drop-out rate not acceptable (28% drop out in intervention group), (9): groups not similar at baseline (control group higher prevalence of physical complaints, exercise group significantly lower sick leave), (11): unacceptable compliance (low and irregular degree of participation)
Griffith et al., 2008	x	(x)	–	–	–	–	–	x	x	(x)	(x)	(x)	x	x	**5**	(3): participants are not blinded (index and control group are distinguishable), (4): care provider is not blinded (index and control group are distinguishable), (5): outcome assessor (self report) not blinded, (6): drop-out rate not acceptable (uneven drop-out), (7) high drop out rate and no intention to treat-analysis
Horneij et al., 2001	(x)	(x)	–	–	x	–	x	x	–	(x)	x	(x)	x	x	**6**	(3): participants are not blinded (index and control group are distinguishable), (4): care provider is not blinded (index and control group are distinguishable), (6): drop-out rate not acceptable (40% drop out), (9): groups not similar at baseline (significant differences between groups in perceived supervisor climate)
Lin et al., 2015	x	(x)	–	–	x	x	x	x	x	(x)	(x)	(x)	–	(x)	**6**	(3): participants are not blinded (index and control group are distinguishable), (4): care provider is not blinded (index and control group are distinguishable), (13): exercises not adequately described, (14): unknown bias because of hospital's funding of the study
Palumbo et al., 2012	(x)	(x)	–	–	–	(x)	x	x	–	(x)	–	(x)	–	–	**2**	(3): participants are not blinded (index and control group are distinguishable), (4): care provider is not blinded (index and control group are distinguishable), (5): outcome assessor (self report) not blinded, (9): groups not similar at baseline (significant differences between groups in perceived stress and workload limitation scores), (11): compliance was not acceptable (irregular attendance (82%) in combination with small sample size), (13): exercises not adequately described, (14): small sample size (N = 11)
Non-randomized controlled trials																
Anderson et al., 2017	/	/	–	–	–	–	/	x	/	(x)	(x)	/	–	–	**1**	(3): participants are not blinded (index and control group are distinguishable), (4): care provider is not blinded (index and control group are distinguishable), (5): outcome assessor (self report) not blinded, (14): very small sample size (N = 9)
Freitas et al., 2014	/	/	–	–	–	x	/	x	/	(x)	(x)	/	–	x	**3**	(3): participants are not blinded (index and control group are distinguishable), (4): care provider is not blinded (index and control group are distinguishable), (5): outcome assessor (self report) not blinded

Note: QA tool accessible at doi: 10.1097/BRS.0000000000001061; x, yes ; (x), unsure; –, no; /, not applicable; (1), Was the method of randomization adequate?; (2), Was the treatment allocation concealed?; (3), Was the patient blinded to the intervention?; (4), Was the care provider blinded to the intervention?; (5),Was the outcome assessor blinded to the intervention?; (6), Was the drop-out rate described and acceptable?; (7), Were all randomized participants analyzed in the group to which they were allocated?; (8), Are reports of the study free of suggestion of selective outcome reporting?; (9), Were the groups similar at baseline regarding the most important prognostic indicators?; (10), Were cointerventions avoided or similar?; (11), Was the compliance acceptable in all groups?; (12), Was the timing of the outcome assessment similar in all groups?; (13), Was the intervention adequately described (content, duration, intensity)?; (14), Are other sources of potential bias unlikely.

assessments used in these studies were the Nursing Stress Scale (NSS), Perceived Stress Scale (PSS), Job Stress Scale (JSS), the Maslach Burnout Inventory (MBI), and two self-generated questionnaires assessing the stress level (Anderson et al., 2017) (Table 2).

4. Discussion

The aim of this study was to systematically review research investigating the effect of physical activity on occupational stress in health personnel in longitudinal intervention studies. The review yielded only 18 intervention studies and only nine studies assessing the effect of single component physical activity on stress in the healthcare sector, even though studies were deliberately not limited to RCT designs. This highlights the need for and the potential of further research in this area of health promotion.

Physical activity types included were any types of voluntary bodily movement including mind-body practices as yoga, tai chi and qigong. Studies in this review evaluated mainly yoga, different forms of worksite exercise recommendations or mindfulness-based interventions including yoga elements. Out of these studies, nine examined the effect of single component physical activity programs. Those single component programs assessed the effect of yoga, worksite training programs, tai chi and qigong on different measures of stress. Solely single component studies were analyzed and assessed regarding study quality in order to better understand potential direct and indirect effects of physical activity on stress in health personnel.

Table 2
Results of single component physical activity intervention studies on stress in health personnel.

Study	Participants, N, sex (female/male), age (M, SD)	Study design (quality score)	Intervention (time spent in supervised intervention in total hours)	Stress Measurement	Results
Alexander et al., 2015	Hospital nurses, N = 40, 39f/1 m, 46.38 ± n.a.	Randomized controlled trial (3)	Supervised yoga instructions (n.a.)	Maslach Burnout Inventory (MBI)	↑ IG significantly better scores for self-care ($p = 0.003$) emotional exhaustion (***p = 0.028**) and depersonalization (***p = 0.048**) than CG post intervention.
Anderson et al., 2017	Registered nurses of an inpatient psychiatric unit, N = 9, 9f/0m, aged from 24 to 49 years	Pilot pre-post intervention study (1)	Yoga nidra (9 h)	Self-generated questionnaire assessing the stress level	↓ no significant stress reduction post intervention
Fang and Li, 2015	Nurses, N = 120, 120f/0m, aged from 25 to 51 years, n.a. ± n.a	Randomized controlled trial with convenience sampling (5)	Yoga (n.a.)	Questionnaire on medical workers' stress (QMWS)	↑ significantly different number of nurses with low and high stress comparing IG and CG post intervention (*****p < 0.001**)
Freitas et al., 2014	Hospital nursing professionals, N = 21, 95.2%f/4,8%m, 37.4 ± 9.1	Quasi-experimental, pre-post intervention study (3)	Workplace physical activity (10 h)	Job Stress Scale (JSS), Maslach Burnout Inventory (MBI)	↓ no significant changes post-intervention
Gerdle et al., 1995	Employees working in a central home care service district, N = 97, 97f/0m, 41 ± 12.8	Randomized, controlled trial (3)	Physical Exercise Intervention (approx. 106 hours)	Self-constructed occupational stress indices	↓ no significant differences between IG and CG post intervention
Griffith et al., 2008	Employees of the Denver Veterans Affairs Medical Center N = 50, 39f/ 11 m, 51 ± 9.5	Randomized, controlled trial (5)	Qigong (12 hours)	Perceived Stress Scale (PSS)	↑ IG significant reduction in perceived stress scores compared to CG (***p = 0.02**)
Horneij et al., 2001	Female nursing aides and assistant nurses working in the home-care service for elderly or handicapped people, N = 282, 282f/0m, 44 ± n.a.	Prospective randomized controlled trial (6)	Individually designed training program (n.a.)	Perceived work-related psychosocial factors by Rubenowitz	↓ no significant stress reduction post-intervention or between groups
Lin et al., 2015	Mental health professionals, N = 60, 48f/12 m, 30.9 ± 7.2	Randomized controlled trial (6)	Yoga (12 hours)	Work-Related Stress Scale, Stress Adaptation Scale, Heart Rate Variability (HRV)	↑ IG significantly decreased work-related stress (****p = 0.002**), but there was no significant change in stress adaptation in HRV (p = 0.084).
Palumbo et al., 2012	Older nurses in an academic medical center, N = 11, 14f/0m, aged 49 years and older	Randomized control trial (2)	Tai Chi (11,25 h supervised)	Nursing Stress Scale (NSS), Perceived Stress Scale (PSS)	↓ no significant differences between IG and CG post intervention

Note: ↑, significant stress reducing effects; ↓, no significant stress reducing effects, IG, intervention group; CG, control group; N, number of participants; f, female; m, male; n.a., not available; p, p-values (boldface indicates statistical significance (*p < 0.05, ***p* < 0.01, ***p < 0.001).

Prior work has suggested the effectiveness of physical activity interventions on stress (von Haaren et al., 2016; Klaperski et al., 2014; Spalding et al., 2004). These studies focused on single component endurance training interventions – mainly running training programs, lasting from six to 20 weeks at intensities ranging from 60 to 85% of participant's maximal heart rate.

Results of the included intervention studies in health personnel vary. But interestingly, most studies that used a single component yoga intervention showed significantly less perceived stress in health personnel after the intervention. The studies that showed no significant results investigated workplace physical activity programs and tai chi. Unfortunately, the exact content of these programs, the intensity at which participants trained, the duration and frequency, and the adherence and drop outs to the programs in these studies were not adequately specified and are therefore difficult to interpret.

Numerous training studies endorse the importance of training above a specific duration and intensity threshold (dose) in order to achieve physiological adaptations to training (response) (Huang et al., 2005; Scribbans et al., 2016). According to the 'cross stressor adaptation hypothesis', exercise results in higher cardiovascular fitness levels and as an indirect consequence in a more efficient physiological way of regulating stress reactions (Forcier et al., 2006; Hackney, 2006). For example, in the study of von Haaren et al. (2016), students completed a 20-week aerobic exercise training (running, twice a week, duration and intensity progressively increased) and hereby significantly increased their aerobic capacity (operationalized via VO_2max). The study indicated that the intervention group significantly reduced their stress reactivity compared to the control group. Gerber (2008) states in his review that null effects were most likely to be found in studies with training intensities below 60% of VO_2max and a duration below 20 min.

Since the studies included in this review which showed no stress reducing effects did not specify intensity and duration, it may well be possible that they did not achieve physiological adaptations in terms of a higher cardiovascular fitness level and were therefore unable to reduce stress in health personnel. Unfortunately, none of the included studies controlled for physiological adaptation, e.g. via VO_2max. This leaves to speculate whether the physical activity chosen as an intervention were ineffective in reducing stress or whether the intensity and duration were too low.

Most notably, this systematic review yielded studies that indicated a positive effect of yoga on occupational stress in health personnel. Previous systematic reviews have investigated the effects of mind body-practices like yoga or qigong on mental health outcomes in various populations and suggest a beneficial effect whilst indicating limited numbers of randomized-controlled trials and methodological flaws (Kwok et al., 2016; Li and Goldsmith, 2012; Posadzki et al., 2010; Wang et al., 2014).

Even though very different types of yoga exist and need to be differentiated, yoga can typically be classified as a light-intensity physical activity (Larson-Meyer, 2016). On the assumption that those interventions did not achieve physiological adaptation, a different stress reducing mechanism of these types of physical activity on health personnel should be considered. According to Gerber and Pühse (2009), besides a more efficient physiological way of regulating stress reactions, a preventive effect of exercise may also occur due to (1) a lowered psychological stress appraisal, (2) the strengthening of other personal (i.e. self-esteem) and social resources (i.e. social support), (3) the protection of stress induced losses of personal and social resources. All of these pathways might be possible explanations for significantly lowered perceived stress in health personnel after yoga interventions as yoga has been suggested to reduce stress through increases in positive attitudes towards stress, self-awareness, coping-mechanisms appraisal of control, calmness, spiritual well-being, self-compassion and mindfulness (Riley and Park, 2015). Kwok et al. (2019) argued that mindfulness yoga might be more effective than convention physical activity intervention for psychological outcomes in participants by adopting a nonjudgmental acceptance of situations and feelings. Similar pathways may be applicable to qigong interventions.

This review cautiously indicates that a total of 12 h of yoga or qigong might be enough to significantly decrease stress in health personnel. These potential effects are promising regarding the popularity of yoga and the increase in the prevalence of yoga practice especially among women (Cramer et al., 2016; Ding and Stamatakis, 2014). With mainly women working in the healthcare sector the assumed stress reducing effect of yoga should be used in order to establish effective health promotion interventions.

Unfortunately, the overall quality of included studies was low. Small sample sizes, high dropout rates and a lack of intention to treat analyses, no blinding, and poor descriptions of the physical activity intervention were main reasons for low quality ratings. Nevertheless, it should be taken into account that methods of evidence based medicine like patient and care provider blinding are not easily applicable to physical activity intervention studies. Sport scientists, trainers or other professionals who provide physical activity interventions as well as participants may not be blinded if programs between intervention and control group have very different features or the control group is a non-intervention or usual-care control group. Researchers should always consider an active control group and at least have the outcome assessor blinded. Moreover, the implementation of physical activity interventions in the setting of the healthcare sector is especially difficult in light of shift-work and staff shortages: High dropout rates and low adherence to the physical activity interventions can be problematic and attenuate the effectiveness of interventional studies in many populations (Sun et al., 2017; Theofilou and Saborit, 2013), but are exceptionally difficult to prevent in healthcare settings due to various environmental challenges. Studies in this review reported problems with recruitment, support from Human Resources (HR) and administration, time constraints, collusion with changing duty rosters and accessible and available room locations. In addition, common barriers leading to non-participation or non-adherence to physical activity interventions like negative psychosocial consequences associated with exercising (e.g., embarrassment or fear of failure in front of colleagues), competing demands on time or the lack of motivation need to be considered (Edmunds et al., 2013; McEachan et al., 2008). Further studies should therefore integrate a bottom-up approach. The participation of different stake holders as well as the target population in intervention planning can help to achieve higher adherence and to prevent drop out (Nielsen et al., 2010; Rütten et al., 2019).

Nonetheless, this review shows the potential of yoga for prevention and health promotion in the healthcare sector. Especially among women yoga has been shown to be a popular type of physical activity and might be easier to promote. The effect of yoga on occupational stress in health personnel should be evaluated in further research.

5. Conclusions

Health personnel need to be supported in their resilience to inevitable occupational stress. This systematic review aimed at investigating whether physical activity interventions might be an effective way in reducing stress.

This review indicates a potential beneficial effect of mind-body practices like yoga or qigong on stress in health professionals. Nevertheless, this review first and foremost highlights the need for further research in this area. Future research should focus on participative intervention planning approaches, randomized studies with an active control group and assess the effect of single component physical activity interventions on stress while differentiating between endurance training in accordance with the 'cross stressor adaptation hypothesis' and mind-body exercises like yoga and qigong. Endurance training interventions should always be planned with intensities higher than 60% of VO_2max and duration of more than 20 min. Furthermore, possible underlying mechanism (e.g. controlling for physiological adaptations via VO_2max or personal resources via self-compassion or mindfulness) should be taken into account and interventions should be described in detail.

Contributions

LLB and AKO were responsible for data collection and analysis. LLB drafted the manuscript. BW, AKO and CH reviewed the paper for important intellectual content.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.ijnurstu.2019.06.002.

References

Abramovitz, M., Zelnick, J., 2010. Double jeopardy: the impact of neoliberalism on care workers in the United States and South Africa. Int. J. Health Serv. 40 (1), 97–117. doi:http://dx.doi.org/10.2190/HS.40.1.f.
Aiken, L.H., Clarke, S.P., Sloane, D.M., Sochalski, J., Silber, J.H., 2002. Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. JAMA 288 (16), 1987–1993.
Alexander, G., 2013. Self-care and yoga-academic-practice collaboration for occupational health. Workplace Health Saf. 61 (12), 510–513. doi:http://dx.doi.org/10.1177/216507991306101202.
Alexander, G.K., Rollins, K., Walker, D., Wong, L., Pennings, J., 2015. Yoga for self-care and burnout prevention among nurses. Workplace Health Saf. 63 (10), 462–470. doi:http://dx.doi.org/10.1177/2165079915596102 quiz 471.
Alexandrova-Karamanova, A., Todorova, I., Montgomery, A., Panagopoulou, E., Costa, P., Baban, A., Davas, A., Milosevic, M., Mijakoski, D., 2016. Burnout and health behaviors in health professionals from seven European countries. Int. Arch. Occup. Environ. Health 89 (7), 1059–1075. doi:http://dx.doi.org/10.1007/s00420-016-1143-5.
Anderson, R., Mammen, K., Paul, P., Pletch, A., Pulia, K., 2017. Using yoga nidra to improve stress in psychiatric nurses in a pilot study. J. Altern. Complement. Med. 23 (6), 494–495. doi:http://dx.doi.org/10.1089/acm.2017.0046.
Asuero, A.M., Queraltó, J.M., Pujol-Ribera, E., Berenguera, A., Rodriguez-Blanco, T., Epstein, R.M., 2014. Effectiveness of a mindfulness education program in primary health care professionals: a pragmatic controlled trial. J. Contin. Educ. Health Prof. 34 (1), 4–12. doi:http://dx.doi.org/10.1002/chp.21211.
Asztalos, M., Wijndaele, K., de Bourdeaudhuij, I., Philippaerts, R., Matton, L., Duvigneaud, N., Thomis, M., Duquet, W., Lefevre, J., Cardon, G., 2009. Specific associations between types of physical activity and components of mental health. J. Sci. Med. Sport 12 (4), 468–474. doi:http://dx.doi.org/10.1016/j.jsams.2008.06.009.
Avila-Palencia, I., de Nazelle, A., Cole-Hunter, T., Donaire-Gonzalez, D., Jerrett, M., Rodriguez, D.A., Nieuwenhuijsen, M.J., 2017. The relationship between bicycle commuting and perceived stress: a cross-sectional study. BMJ Open 7 (6) e013542 doi:http://dx.doi.org/10.1136/bmjopen-2016-013542.
Bair, J.P., Greenspan, B.K., 1986. TEAMS: teamwork training for interns, residents, and nurses. Hosp. Commun. Psychiatry 37 (6), 633–635.
Bernburg, M., Vitzthum, K., Groneberg, D.A., Mache, S., 2016. Physicians' occupational stress, depressive symptoms and work ability in relation to their working environment: a cross-sectional study of differences among medical

residents with various specialties working in German hospitals. BMJ Open 6 (6) e011369 doi:http://dx.doi.org/10.1136/bmjopen-2016-011369.
Bhatia, V., Tandon, R.K., 2005. Stress and the gastrointestinal tract. J. Gastroenterol. Hepatol. 20 (3), 332–339. doi:http://dx.doi.org/10.1111/j.1440-1746.2004.03508.x.
Blair, S.N., Applegate, W.B., Dunn, A.L., Ettinger, W.H., Haskell, W.L., King, A.C., Morgan, T.M., Shih, J.A., Simons-Morton, D.G., 1998. Activity Counseling Trial (ACT): rationale, design, and methods. Activity Counseling Trial Research Group. Med. Sci. Sports Exerc. 30 (7), 1097–1106.
Blake, H., Gartshore, E., 2016. Workplace wellness using online learning tools in a healthcare setting. Nurse Educ. Pract. 20, 70–75. doi:http://dx.doi.org/10.1016/j.nepr.2016.07.001.
Blake, H., Lee, S., 2007. Health of community nurses: a case for workplace wellness schemes. Br. J. Commun. Nurs. 12 (6), 263–267.
Bolden, L., Cuevas, N., Raia, L., Meredith, E., Prince, T., 2011. The use of reflective practice in new graduate registered nurses residency program. Nurs. Adm. Q. 35 (2), 134–139. doi:http://dx.doi.org/10.1097/NAQ.0b013e31820feb5e.
Brennan, J., McGrady, A., 2015. Designing and implementing a resiliency program for family medicine residents. Int. J. Psychiatry Med. 50 (1), 104–114. doi:http://dx.doi.org/10.1177/0091217415592369.
Bridger, R.S., Day, A.J., Morton, K., 2013. Occupational stress and employee turnover. Ergonomics 56 (11), 1629–1639. doi:http://dx.doi.org/10.1080/00140139.2013.836251.
Caspersen, C.J., Powell, K.E., Christenson, G.M., 1985. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Rep. 100 (2), 126–131.
Coleman, J.F., 2011. Spring forest qigong and chronic pain: making a difference. J. Holistic Nurs. 29 (2), 118–128. doi:http://dx.doi.org/10.1177/0898010110385939.
Cramer, H., Ward, L., Steel, A., Lauche, R., Dobos, G., Zhang, Y., 2016. Prevalence, patterns, and predictors of yoga use: results of a U.S. nationally representative survey. Am. J. Prev. Med. 50 (2), 230–235. doi:http://dx.doi.org/10.1016/j.amepre.2015.07.037.
Cronin-Stubbs, D., Pencak, M., 1989. Exercise may evoke rather than reduce stress. J. Nurs. Adm. 19 (7), 3.
Davis, C., Cooke, M., Holzhauser, K., Jones, M., Finucane, J., 2005. The effect of aromatherapy massage with music on the stress and anxiety levels of emergency nurses. Australas. Emerg. Nurs. J. 8 (1/2), 43–50.
Deloitte, 2018. 2019 Global Health Care Outlook: The Evolution of Smart Health CareDeloitte Touche Thomtsu Limited. . (Accessed 20 February 2019) https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Life-Sciences-Health-Care/gx-lshc-hc-outlook-2018.pdf.
Ding, D., Stamatakis, E., 2014. Yoga practice in England 1997-2008: prevalence, temporal trends, and correlates of participation. BMC Res. Notes 7, 172. doi:http://dx.doi.org/10.1186/1756-0500-7-172.
Duchemin, A.-M., Steinberg, B.A., Marks, D.R., Vanover, K., Klatt, M., 2015. A small randomized pilot study of a workplace mindfulness-based intervention for surgical intensive care unit personnel: effects on salivary α-amylase levels. J. Occup. Environ. Med. 57 (4), 393–399.
Duncan, A.D., Liechty, J.M., Miller, C., Chinoy, G., Ricciardi, R., 2011. Employee use and perceived benefit of a complementary and alternative medicine wellness clinic at a major military hospital: evaluation of a pilot program. J. Altern. Complement. Med. 17 (9), 809–815. doi:http://dx.doi.org/10.1089/acm.2010.0563.
Edmunds, S., Hurst, L., Harvey, K., 2013. Physical activity barriers in the workplace. Int. J. Workplace Health Manage. 6 (3), 227–240. doi:http://dx.doi.org/10.1108/IJWHM-11-2010-0040.
Fang, R., Li, X., 2015. A regular yoga intervention for staff nurse sleep quality and work stress: a randomised controlled trial. J. Clin. Nurs. 24 (23–24), 3374–3379. doi:http://dx.doi.org/10.1111/jocn.12983.
Farquharson, B., Bell, C., Johnston, D., Jones, M., Schofield, P., Allan, J., Ricketts, I., Morrison, K., Johnston, M., 2013. Nursing stress and patient care: real-time investigation of the effect of nursing tasks and demands on psychological stress, physiological stress, and job performance: study protocol. J. Adv. Nurs. 69 (10), 2327–2335. doi:http://dx.doi.org/10.1111/jan.12090.
Forcier, K., Stroud, L.R., Papandonatos, G.D., Hitsman, B., Reiches, M., Krishnamoorthy, J., Niaura, R., 2006. Links between physical fitness and cardiovascular reactivity and recovery to psychological stressors: a meta-analysis. Health Psychol. 25 (6), 723–739. doi:http://dx.doi.org/10.1037/0278-6133.25.6.723.
Freitas, A.R., Carneseca, E.C., Paiva, C.E., Sakamoto Ribeiro Paiva, B., 2014. Impact of a physical activity program on the anxiety, depression, occupational stress and burnout syndrome of nursing professionals. Rev. Lat. Enfermagem 22 (2), 332–336. doi:http://dx.doi.org/10.1590/0104-1169.3307.2420.
Furlan, A.D., Malmivaara, A., Chou, R., Maher, C.G., Deyo, R.A., Schoene, M., Bronfort, G., van Tulder, M.W., 2015. 2015 updated method guideline for systematic reviews in the Cochrane Back and Neck Group. Spine 40 (21), 1660–1673. doi:http://dx.doi.org/10.1097/BRS.0000000000001061.
Gerber, M., 2008. Sportliche Aktivität und Stressreaktivität: Ein Review. Deutsche Zeitschrift für Sportmedizin 59 (7-8), 168–174.
Gerber, M., Pühse, U., 2008. "Don't crack under pressure!"—do leisure time physical activity and self-esteem moderate the relationship between school-based stress and psychosomatic complaints? J. Psychosom. Res. 65 (4), 363–369. doi:http://dx.doi.org/10.1016/j.jpsychores.2008.06.012.
Gerber, M., Pühse, U., 2009. Review article: do exercise and fitness protect against stress-induced health complaints? A review of the literature. Scand. J. Public Health 37 (8), 801–819. doi:http://dx.doi.org/10.1177/1403494809350522.
Gerber, M., Jonsdottir, I.H., Lindwall, M., Ahlborg, G., 2014. Physical activity in employees with differing occupational stress and mental health profiles: a latent profile analysis. Psychol. Sport Exerc. 15 (6), 649–658. doi:http://dx.doi.org/10.1016/j.psychsport.2014.07.012.
Gerdle, B., Brulin, C., Elert, J., Eliasson, P., Granlund, B., 1995. Effect of a general fitness program on musculoskeletal symptoms, clinical status, physiological capacity, and perceived work environment among home care service personnel. J. Occup. Rehabil. 5 (1), 1–16.
Gnam, J.-P., Loeffler, S.-N., Haertel, S., Engel, F., Hey, S., Boes, K., Woll, A., Strahler, J., 2018. On the relationship between physical activity, physical fitness, and stress reactivity to a real-life mental stressor. Int. J. Stress Manag. doi:http://dx.doi.org/10.1037/str0000113.
Griffith, J.M., Hasley, J.P., Liu, H., Severn, D.G., Conner, L.H., Adler, L.E., 2008. Qigong stress reduction in hospital staff. J. Altern. Complement. Med. 14 (8), 939–945. doi:http://dx.doi.org/10.1089/acm.2007.0814.
Hackney, A.C., 2006. Stress and the neuroendocrine system: the role of exercise as a stressor and modifier of stress. Expert Rev. Endocrinol. Metab. 1 (6), 783–792. doi:http://dx.doi.org/10.1586/17446651.1.6.783.
Hall, L., Johnson, J., Watt, I., Tsipa, A., O'Connor, D.B., 2016. Healthcare staff wellbeing, burnout, and patient safety: a systematic review. PLoS One 11 (7) e0159015 doi:http://dx.doi.org/10.1371/journal.pone.0159015.
Hasson, H., Arnetz, J.E., 2008. Nursing staff competence, work strain, stress and satisfaction in elderly care: a comparison of home-based care and nursing homes. J. Clin. Nurs. 17 (4), 468–481. doi:http://dx.doi.org/10.1111/j.1365-2702.2006.01803.x.
Hofmann, D.A., Burke, M.J., Zohar, D., 2017. 100 years of occupational safety research: from basic protections and work analysis to a multilevel view of workplace safety and risk. J. Appl. Psychol. 102 (3), 375–388. doi:http://dx.doi.org/10.1037/apl0000114.
Hope, A., Kelleher, C.C., O'Connor, M., 1998. Lifestyle practices and the health promoting environment of hospital nurses. J. Adv. Nurs. 28 (2), 438–447. doi:http://dx.doi.org/10.1046/j.1365-2648.1998.00791.x.
Horneij, E., Hemborg, B., Jensen, I., Ekdahl, C., 2001. No significant differences between intervention programmes on neck, shoulder and low back pain: a prospective randomized study among home-care personnel. J. Rehabil. Med. (16501977) 33 (4), 170–176.
Huang, G., Gibson, C.A., Tran, Z.V., Osness, W.H., 2005. Controlled endurance exercise training and VO2max changes in older adults: a meta-analysis. Prev. Cardiol. 8 (4), 217–225. doi:http://dx.doi.org/10.1111/j.0197-3118.2005.04324.x.
Jacobsen, H.B., Reme, S.E., Sembajwe, G., Hopcia, K., Stiles, T.C., Sorensen, G., Porter, J. H., Marino, M., Buxton, O.M., 2014. Work stress, sleep deficiency, and predicted 10-year cardiometabolic risk in a female patient care worker population. Am. J. Ind. Med. 57 (8), 940–949. doi:http://dx.doi.org/10.1002/ajim.22340.
Jayasinghe, S.U., Lambert, G.W., Torres, S.J., Fraser, S.F., Eikelis, N., Turner, A.I., 2016. Hypothalamo-pituitary adrenal axis and sympatho-adrenal medullary system responses to psychological stress were not attenuated in women with elevated physical fitness levels. Endocrine 51 (2), 369–379. doi:http://dx.doi.org/10.1007/s12020-015-0687-6.
Johnson, J.R., Emmons, H.C., Rivard, R.L., Griffin, K.H., Dusek, J.A., 2015. Resilience training: a pilot study of a mindfulness-based program with depressed healthcare professionals. Explore (New York, N.Y.) 11 (6), 433–444. doi:http://dx.doi.org/10.1016/j.explore.2015.08.002.
Jonsdottir, I.H., Rödjer, L., Hadzibajramovic, E., Börjesson, M., Ahlborg, G., 2010. A prospective study of leisure-time physical activity and mental health in Swedish health care workers and social insurance officers. Prev. Med. 51 (5), 373–377. doi:http://dx.doi.org/10.1016/j.ypmed.2010.07.019.
Khamisa, N., Peltzer, K., Ilic, D., Oldenburg, B., 2016. Work related stress, burnout, job satisfaction and general health of nurses: a follow-up study. Int. J. Nurs. Pract. 22 (6), 538–545. doi:http://dx.doi.org/10.1111/ijn.12455.
Kivimäki, M., Nyberg, S.T., Fransson, E.I., Heikkilä, K., Alfredsson, L., Casini, A., Clays, E., de Bacquer, D., Dragano, N., Ferrie, J.E., Goldberg, M., Hamer, M., Jokela, M., Karasek, R., Kittel, F., Knutsson, A., Koskenvuo, M., Nordin, M., Oksanen, T., Pentti, J., Rugulies, R., Salo, P., Siegrist, J., Suominen, S.B., Theorell, T., Vahtera, J., Virtanen, M., Westerholm, P.J.M., Westerlund, H., Zins, M., Steptoe, A., Singh-Manoux, A., Batty, G.D., 2013. Associations of job strain and lifestyle risk factors with risk of coronary artery disease: a meta-analysis of individual participant data. CMAJ: Can. Med. Assoc. J.= journal de l'Association medicale canadienne 185 (9), 763–769. doi:http://dx.doi.org/10.1503/cmaj.121735.
Klaperski, S., von Dawans, B., Heinrichs, M., Fuchs, R., 2014. Effects of a 12-week endurance training program on the physiological response to psychosocial stress in men: a randomized controlled trial. J. Behav. Med. 37 (6), 1118–1133. doi:http://dx.doi.org/10.1007/s10865-014-9562-9.
Klatt, M., Steinberg, B., Duchemin, A.-M., 2015. Mindfulness in Motion (MIM): an Onsite Mindfulness Based Intervention (MBI) for chronically high stress work environments to increase resiliency and work engagement. J. Vis. Exp.: JoVE (101), e52359. doi:http://dx.doi.org/10.3791/52359.
Kwok, J.Y.Y., Choi, K.C., Chan, H.Y.L., 2016. Effects of mind-body exercises on the physiological and psychosocial well-being of individuals with Parkinson's disease: a systematic review and meta-analysis. Complement. Ther. Med. 29, 121–131. doi:http://dx.doi.org/10.1016/j.ctim.2016.09.016.
Kwok, J.Y.Y., Kwan, J.C.Y., Auyeung, M., Mok, V.C.T., Lau, C.K.Y., Choi, K.C., Chan, H.Y.L., 2019. Effects of mindfulness yoga vs stretching and resistance training exercises on anxiety and depression for people with Parkinson disease: a randomized clinical trial. JAMA Neurol. doi:http://dx.doi.org/10.1001/jamaneurol.2019.0534 Epub ahead of print.
Lagerstrom, M., Hagberg, M., 1997. Evaluation of a 3 year education and training program for nursing personnel at a Swedish hospital. AAOHN J. 45 (2), 83–92.

Lahn, M.J., 2015. Indices of heart rate variability and compassion in healthcare professionals following stress resilience training. Dissertation Abstracts International: Section B: The Sciences and Engineering 75 (11-B(E)), No-Specified, .

Landsbergis, P.A., Dobson, M., Koutsouras, G., Schnall, P., 2013. Job strain and ambulatory blood pressure: a meta-analysis and systematic review. Am. J. Public Health 103 (3), e61–71. doi:http://dx.doi.org/10.2105/AJPH.2012.301153.

Larson-Meyer, D.E., 2016. A systematic review of the energy cost and metabolic intensity of yoga. Med. Sci. Sports Exerc. 48 (8), 1558–1569. doi:http://dx.doi.org/10.1249/MSS.0000000000000922.

Lavoie-Tremblay, M., Sounan, C., Trudel, J.G., Lavigne, G.L., Martin, K., Lowensteyn, I., 2014. Impact of a pedometer program on nurses working in a health-promoting hospital. Health Care Manag. 33 (2), 172–180.

Lazarus, R.S., Folkman, S., 1987. Transactional theory and research on emotions and coping. Eur. J. Pers. 1 (3), 141–169. doi:http://dx.doi.org/10.1002/per.2410010304.

Lear, S.A., Hu, W., Rangarajan, S., Gasevic, D., Leong, D., Iqbal, R., Casanova, A., Swaminathan, S., Anjana, R.M., Kumar, R., Rosengren, A., Wei, L., Yang, W., Chuangshi, W., Huaxing, L., Nair, S., Diaz, R., Swidon, H., Gupta, R., Mohammadifard, N., Lopez-Jaramillo, P., Oguz, A., Zatonska, K., Seron, P., Avezum, A., Poirier, P., Teo, K., Yusuf, S., 2017. The effect of physical activity on mortality and cardiovascular disease in 130 000 people from 17 high-income, middle-income, and low-income countries: the PURE study. Lancet 390 (10113), 2643–2654. doi:http://dx.doi.org/10.1016/S0140-6736(17)31634-3.

Li, A.W., Goldsmith, C.-A.W., 2012. The effects of yoga on anxiety and stress. Altern. Med. Rev. 17 (1), 21–35.

Lin, S.-L., Huang, C.-Y., Shiu, S.-P., Yeh, S.-H., 2015. Effects of yoga on stress, stress adaption, and heart rate variability among mental health professionals—a randomized controlled trial. Worldviews Evid. Nurs. 12 (4), 236–245. doi:http://dx.doi.org/10.1111/wvn.12097.

Lindgren, M., Alex, C., Shapiro, P.A., McKinley, P.S., Brondolo, E.N., Myers, M.M., Choi, C.J., Lopez-Pintado, S., Sloan, R.P., 2013. Effects of aerobic conditioning on cardiovascular sympathetic response to and recovery from challenge. Psychophysiology 50 (10), 963–973. doi:http://dx.doi.org/10.1111/psyp.12078.

Lindwall, M., Gerber, M., Jonsdottir, I.H., Börjesson, M., Ahlborg, G., 2014. The relationships of change in physical activity with change in depression, anxiety, and burnout: a longitudinal study of Swedish healthcare workers. Health Psychol. 33 (11), 1309–1318. doi:http://dx.doi.org/10.1037/a0034402.

Lippke, S., Wienert, J., Kuhlmann, T., Fink, S., Hambrecht, R., 2015. Perceived stress, physical activity and motivation: findings from an internet study. Ann. Sports Med. Res. 2, 1012.

Low, V., Gebhart, B., Reich, C., 2015. Effects of a worksite program to improve the cardiovascular health of female health care workers. J. Cardiopulm. Rehabil. Prev. 35 (5), 342–347. doi:http://dx.doi.org/10.1097/HCR.0000000000000116.

Malinauskiene, V., Leisyte, P., Romualdas, M., Kirtiklyte, K., 2011. Associations between self-rated health and psychosocial conditions, lifestyle factors and health resources among hospital nurses in Lithuania. J. Adv. Nurs. 67 (11), 2383–2393. doi:http://dx.doi.org/10.1111/j.1365-2648.2011.05685.x.

Maresso, A., Mladovsky, P., Thomson, S., Sagan, A., Karanikolos, M., Richardson, E., Cylus, J., Evetovits, T., Jowett, M., Figueras, J., Kluge, H. (Eds.), 2015. Economic Crisis, Health Systems and Health in Europe: Country Experience.. World Health Organization Regional Office for Europe; European Observatory on Health Systems and Policies, Copenhagen 1554 pp..

Martin, A.C., Keats, M.R., 2014. The impact of yoga on quality of life and psychological distress in caregivers for patients with cancer. Oncol. Nurs. Forum 41 (3), 257–264. doi:http://dx.doi.org/10.1188/14.ONF.257-264.

Martín-Asuero, A., García-Banda, G., 2010. The Mindfulness-based Stress Reduction program (MBSR) reduces stress-related psychological distress in healthcare professionals. Span. J. Psychol. 13 (2), 897–905.

Mason, L., 2001. Evidence-based midwifery in action. Guidelines on the teaching of pelvic floor exercises. Br. J. Midwifery 9 (10), 608–611.

McEachan, R.R.C., Lawton, R.J., Jackson, C., Conner, M., Lunt, J., 2008. Evidence, theory and context: using intervention mapping to develop a worksite physical activity intervention. BMC Public Health 8, 326. doi:http://dx.doi.org/10.1186/1471-2458-8-326.

McHugh, M.L., 2012. Interrater reliability: the kappa statistic. Biochem. Med. 22 (3), 276–282.

McVicar, A., 2003. Workplace stress in nursing: a literature review. J. Adv. Nurs. 44 (6), 633–642. doi:http://dx.doi.org/10.1046/j.0309-2402.2003.02853.x.

Mealer, M., Conrad, D., Evans, J., Jooste, K., Solyntjes, J., Rothbaum, B., Moss, M., 2014. Feasibility and acceptability of a resilience training program for intensive care unit nurses. Am. J. Crit. Care 23 (6), e97–105. doi:http://dx.doi.org/10.4037/ajcc2014747.

Michie, S., Williams, S., 2003. Reducing work related psychological ill health and sickness absence: a systematic literature review. Occup. Environ. Med. 60 (1), 3–9.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., 2009. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. 6 (7) e1000097 doi:http://dx.doi.org/10.1371/journal.pmed.1000097.

Muncer, S., Taylor, S., Green, D.W., McManus, I.C., 2001. Nurses' representations of the perceived causes of work-related stress: a network drawing approach. Work Stress 15 (1), 40–52. doi:http://dx.doi.org/10.1080/02678370110063402.

Nguyen-Michel, S.T., Unger, J.B., Hamilton, J., Spruijt-Metz, D., 2006. Associations between physical activity and perceived stress/hassles in college students. Stress Health 22 (3), 179–188. doi:http://dx.doi.org/10.1002/smi.1094.

Nielsen, K., Randall, R., Holten, A.-L., González, E.R., 2010. Conducting organizational-level occupational health interventions: what works? Work Stress 24 (3), 234–259. doi:http://dx.doi.org/10.1080/02678373.2010.515393.

Nübling, M., Vomstein, M., Schmidt, S.G., Gregersen, S., Dulon, M., Nienhaus, A., 2010. Psychosocial work load and stress in the geriatric care. BMC Public Health 10, 428. doi:http://dx.doi.org/10.1186/1471-2458-10-428.

Otto, L.A., 2009. Exploring the stress response in new army nurses. Exploring the Stress Response in New Army Nurses (Ph.D), 134 p..

Palumbo, M.V., Wu, G., Shaner-McRae, H., Rambur, B., McIntosh, B., 2012. Tai Chi for older nurses: a workplace wellness pilot study. Appl. Nurs. Res. 25 (1), 54–59.

Pedrazza, M., Berlanda, S., Trifiletti, E., Bressan, F., 2016. Exploring physicians' dissatisfaction and work-related stress: development of the PhyDis scale. Front. Psychol. 7, 187. doi:http://dx.doi.org/10.3389/fpsyg.2016.01238.

Poghosyan, L., Clarke, S.P., Finlayson, M., Aiken, L.H., 2010. Nurse burnout and quality of care: cross-national investigation in six countries. Res. Nurs. Health 33 (4), 288–298. doi:http://dx.doi.org/10.1002/nur.20383.

Posadzki, P., Parekh, S., Glass, N., 2010. Yoga and qigong in the psychological prevention of mental health disorders: a conceptual synthesis. Chin. J. Integr. Med. 16 (1), 80–86. doi:http://dx.doi.org/10.1007/s11655-009-9002-2.

Repar, P.A., Patton, D., 2007. Stress reduction for nurses through arts-in-medicine at the university of new Mexico hospitals. Holist. Nurs. Pract. 21 (4), 182–186. doi:http://dx.doi.org/10.1097/01.HNP.0000280929.68259.5c.

Rieger, A., Stoll, R., Kreuzfeld, S., Behrens, K., Weippert, M., 2014. Heart rate and heart rate variability as indirect markers of surgeons' intraoperative stress. Int. Arch. Occup. Environ. Health 87 (2), 165–174. doi:http://dx.doi.org/10.1007/s00420-013-0847-z.

Riley, K.E., Park, C.L., 2015. How does yoga reduce stress? A systematic review of mechanisms of change and guide to future inquiry. Health Psychol. Rev. 9 (3), 379–396. doi:http://dx.doi.org/10.1080/17437199.2014.981778.

Rimmele, U., Seiler, R., Marti, B., Wirtz, P.H., Ehlert, U., Heinrichs, M., 2009. The level of physical activity affects adrenal and cardiovascular reactivity to psychosocial stress. Psychoneuroendocrinology 34 (2), 190–198. doi:http://dx.doi.org/10.1016/j.psyneuen.2008.08.023.

Rütten, A., Frahsa, A., Abel, T., Bergmann, M., de Leeuw, E., Hunter, D., Jansen, M., King, A., Potvin, L., 2019. Co-producing active lifestyles as whole-system-approach: theory, intervention and knowledge-to-action implications. Health Promot. Int. 34 (1), 47–59. doi:http://dx.doi.org/10.1093/heapro/dax053.

Sallon, S., Katz-Eisner, D., Yaffe, H., Bdolah-Abram, T., 2017. Caring for the caregivers: results of an extended, five-component stress-reduction intervention for hospital staff. Behav. Med. (Washington, D.C.) 43 (1), 47–60. doi:http://dx.doi.org/10.1080/08964289.2015.1053426.

Sarma, S., Devlin, R.A., Gilliland, J., Campbell, M.K., Zaric, G.S., 2015. The effect of leisure-time physical activity on obesity, diabetes, high BP and heart disease among Canadians: evidence from 2000/2001 to 2005/2006. Health Econ. 24 (12), 1531–1547. doi:http://dx.doi.org/10.1002/hec.3106.

Scribbans, T.D., Vecsey, S., Hankinson, P.B., Foster, W.S., Gurd, B.J., 2016. The effect of training intensity on VO2max in young healthy adults: a meta-regression and meta-analysis. Int. J. Exerc. Sci. 9 (2), 230–247.

Sehlen, S., Vordermark, D., Schäfer, C., Herschbach, P., Bayerl, A., Pigorsch, S., Rittweger, J., Dormin, C., Bölling, T., Wypior, H.J., Zehentmayr, F., Schulze, W., Geinitz, H., 2009. Job stress and job satisfaction of physicians, radiographers, nurses and physicists working in radiotherapy: a multicenter analysis by the DEGRO Quality of Life Work Group. Radiat. Oncol. (London, England) 4, 6. doi:http://dx.doi.org/10.1186/1748-717X-4-6.

Sloan, R.P., Shapiro, P.A., DeMeersman, R.E., Bagiella, E., Brondolo, E.N., McKinley, P.S., Crowley, O., Zhao, Y., Schwartz, J.E., Myers, M.M., 2011. Impact of aerobic training on cardiovascular reactivity to and recovery from challenge. Psychosom. Med. 73 (2), 134–141. doi:http://dx.doi.org/10.1097/PSY.0b013e31820a1174.

Smits, J.A.J., Tart, C.D., Rosenfield, D., Zvolensky, M.J., 2011. The interplay between physical activity and anxiety sensitivity in fearful responding to carbon dioxide challenge. Psychosom. Med. 73 (6), 498–503. doi:http://dx.doi.org/10.1097/PSY.0b013e3182223b28.

Spalding, T.W., Lyon, L.A., Steel, D.H., Hatfield, B.D., 2004. Aerobic exercise training and cardiovascular reactivity to psychological stress in sedentary young normotensive men and women. Psychophysiology 41 (4), 552–562. doi:http://dx.doi.org/10.1111/j.1469-8986.2004.00184.x.

Spooner-Lane, R., 2004. The Influence of Work Stress and Work Support on Burnout in Public Hospital Nurses. Doctoral dissertation, Brisbane. .

Stansfeld, S., Candy, B., 2006. Psychosocial work environment and mental health—a meta-analytic review. Scand. J. Work Environ. Health 32 (6), 443–462. doi:http://dx.doi.org/10.5271/sjweh.1050.

Steinberg, B.A., Klatt, M., Duchemin, A.-M., 2016. Feasibility of a mindfulness-based intervention for surgical intensive care unit personnel. Am. J. Crit. Care 26 (1), 10–18. doi:http://dx.doi.org/10.4037/ajcc2017444.

Sun, H., Vamos, C.A., Flory, S.S.B., DeBate, R., Thompson, E.L., Bleck, J., 2017. Correlates of long-term physical activity adherence in women. J. Sport Health Sci. 6 (4), 434–442. doi:http://dx.doi.org/10.1016/j.jshs.2016.01.009.

Szeto, G.P.Y., Law, K.Y., Lee, E., Lau, T., Chan, S.Y., Law, S.-W., 2010. Multifaceted ergonomic intervention programme for community nurses: pilot study. J. Adv. Nurs. 66 (5), 1022–1034. doi:http://dx.doi.org/10.1111/j.1365-2648.2009.05255.x.

Tang, R., Tegeler, C., Larrimore, D., Cowgill, S., Kemper, K.J., 2010. Improving the well-being of nursing leaders through healing touch training. J. Altern. Complement. Med. 16 (8), 837–841. doi:http://dx.doi.org/10.1089/acm.2009.0558.

Tarantino, B., Earley, M., Audia, D., D'Adamo, C., Berman, B., 2013. Qualitative and quantitative evaluation of a pilot integrative coping and resiliency program for healthcare professionals. Explore (New York, N.Y.) 9 (1), 44–47. doi:http://dx.doi.org/10.1016/j.explore.2012.10.002.

Theofilou, P., Saborit, A.R., 2013. Adherence and physical activity. Health Psychol. Res. 1 (1) doi:http://dx.doi.org/10.4081/hpr.2013.e6.
Thomas, O.'N., Patricia, Kathryn, S., Tom, F., 2017. A multimodal mindfulness training to address mental health symptoms in providers who care for and interact with children in relation to end-of-life care. Am. J. Hosp. Palliat. Med. 34 (9), 838–873. doi:http://dx.doi.org/10.1177/1049909116660688.
Tveito, T.H., Eriksen, H.R., 2009. Integrated health programme: a workplace randomized controlled trial. J. Adv. Nurs. 65 (1), 110–119. doi:http://dx.doi.org/10.1111/j.1365-2648.2008.04846.x.
Umann, J., Marques da Silva, R., Ticona Benavente, S.B., de Azevedo Guido, L., 2014. The impact of coping strategies on the intensity of stress on hemato-oncology nurses. Rev. Gaucha Enfermagem 35 (3), 103–110. doi:http://dx.doi.org/10.1590/1983-1447.2014.03.44642.
van Bogaert, P., Dilles, T., Wouters, K., van Rompaey, B., 2014. Practice environment, work characteristics and levels of burnout as predictors of nurse reported job outcomes, quality of care and patient adverse events: a study across residential aged care services. OJN 4 (5), 343–355. doi:http://dx.doi.org/10.4236/ojn.2014.45040.
von Haaren, B., Ottenbacher, J., Muenz, J., Neumann, R., Boes, K., Ebner-Priemer, U., 2016. Does a 20-week aerobic exercise training programme increase our capabilities to buffer real-life stressors? A randomized, controlled trial using ambulatory assessment. Eur. J. Appl. Physiol. 116 (2), 383–394. doi:http://dx.doi.org/10.1007/s00421-015-3284-8.
von Känel, R., Mausbach, B.T., Dimsdale, J.E., Mills, P.J., Patterson, T.L., Ancoli-Israel, S., Ziegler, M.G., Roepke, S.K., Harmell, A.L., Allison, M., Grant, I., 2011. Regular physical activity moderates cardiometabolic risk in Alzheimer's caregivers. Med. Sci. Sports Exerc. 43 (1), 181–189. doi:http://dx.doi.org/10.1249/MSS.0b013e3181e6d478.
Waelde, L.C., Thompson, L., Gallagher-Thompson, D., 2004. A pilot study of a yoga and meditation intervention for dementia caregiver stress. J. Clin. Psychol. 60 (6), 677–687. doi:http://dx.doi.org/10.1002/jclp.10259.
Wald, H.S., Haramati, A., Bachner, Y.G., Urkin, J., 2016. Promoting resiliency for interprofessional faculty and senior medical students: outcomes of a workshop using mind-body medicine and interactive reflective writing. Med. Teach. 38 (5), 525–528. doi:http://dx.doi.org/10.3109/0142159X.2016.1150980.
Wang, C.-W., Chan, C.H.Y., Ho, R.T.H., Chan, J.S.M., Ng, S.-M., Chan, C.L.W., 2014. Managing stress and anxiety through qigong exercise in healthy adults: a systematic review and meta-analysis of randomized controlled trials. BMC Complement. Altern. Med. 14, 8. doi:http://dx.doi.org/10.1186/1472-6882-14-8.
Weinberg, A., Creed, F., 2000. Stress and psychiatric disorder in healthcare professionals and hospital staff. Lancet 355 (9203), 533–537. doi:http://dx.doi.org/10.1016/S0140-6736(99)07366-3.
Wijndaele, K., Matton, L., Duvigneaud, N., Lefevre, J., de Bourdeaudhuij, I., Duquet, W., Thomis, M., Philippaerts, R.M., 2007. Association between leisure time physical activity and stress, social support and coping: a cluster-analytical approach. Psychol. Sport Exerc. 8 (4), 425–440. doi:http://dx.doi.org/10.1016/j.psychsport.2006.08.001.
Wollesen, B., Voelcker-Rehage, C., 2014. Training effects on motor–cognitive dual-task performance in older adults. Eur. Rev. Aging Phys. Act. 11 (1), 5–24. doi:http://dx.doi.org/10.1007/s11556-013-0122-z.
Wright, E.M., 2018. Evaluation of a web-based holistic stress reduction pilot program among nurse-midwives. J. Holist. Nurs. 36 (2), 159–169. doi:http://dx.doi.org/10.1177/0898010117704325.
Yamagishi, M., Kobayashi, T., Kobayashi, T., Nagami, M., Shimazu, A., Kageyama, T., 2007. Effect of web-based assertion training for stress management of Japanese nurses. J. Nurs. Manage. 15 (6), 603–607. doi:http://dx.doi.org/10.1111/j.1365-2834.2007.00739.x.
Yao, S.-q., Tian, L., Pang, B.-d., Bai, Y.-p., Fan, X.-y., Shen, F.-h., Jin, Y.-l., 2008. Investigation on job stress of pediatricians and nurses working in pediatric department. Zhonghua lao dong wei sheng zhi ye bing za zhi = Zhonghua laodong weisheng zhiyebing zazhi = Chin. J. Ind. Hyg. Occup. Dis. 26 (9), 529–532.
Yorks, D.M., Frothingham, C.A., Schuenke, M.D., 2017. Effects of group fitness classes on stress and quality of life of medical students. J. Am. Osteopath. Assoc. 117 (11), e17–e25. doi:http://dx.doi.org/10.7556/jaoa.2017.140.
Zimber, A., Rudolf, A., Teufel, S., 2001. A training program to reduce distress among geriatric caregivers. Arbeitsbelastungen in der Altenpflege reduzieren: Ein Trainingsprogramm fur Mitarbeiter und Leitungkrafte 34 (5), 401–407. doi:http://dx.doi.org/10.1007/s003910170042.