26

Stress Management for Medical Students: A Systematic Review

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1. Introduction

Tertiary education has always been regarded as highly stressful environment to students (Saipanish, 2003; Sherina et. al, 2003). Medical training further adds to the already stressful environment. Studies have revealed a high prevalence of psychological distress in medical students, ranging from 21.6% to 56% (Aktekin et al., 2001; Chandrasekhar et al., 2007; Dahlin et al., 2005; Firth, 1986; Guthrie et al., 1995; Miller & Surtees, 1991; Johari & Hashim, 2009; Saipanish, 2003; Sherina et al., 2003; Yusoff et al., 2011; Yusoff et al., 2010; Zaid et. al, 2007). Two studies in Malaysian government universities reported that 29.1 % to 41.9% of the medical students surveyed had psychological distress (Sherina et al., 2003; Yusoff et al., 2010) and another study in a Malaysian private medical school reported that 46.2% had psychological distress (Zaid et al, 2007). Apart from that, the stress level is higher in medical students compared to students in other courses. A study in Singapore reported that 57% of medical students had psychological distress compared to 47.3% of law students (Ko et al., 1999). Another study in Turkey reported that 47.9% of medical students had psychological distress compared to 29.2% of economic and physical education students as measured by GHQ (Aktekin et al., 2001). The alarming facts suggested that a sense of growing pressure on medical students.

The prevalence of psychological distress among year 1 medical students ranged from 17.6% to 50% (Aktekin et al., 2001; Guthrie et al., 1998; Sherina et al., 2003; Yusoff et al., 2011; Zaid et., 2007). The prevalence of psychological distress among year 2 medical students ranged from 36.5% to 47.9% (Aktekin et al., 2001; Sherina et al., 2003; Yusoff et al., 2010). The prevalence of psychological distress among year 3 medical students ranged from 29.8% to 40.5% (Sherina et al., 2003; Yusoff et al., 2010; Zaid et al., 2007). The prevalence of psychological distress among year 4 medical students ranged from 28.3% to 48.7% (Guthrie et al., 1998; Sherina et al., 2003; Yusoff et al., 2010; Zaid et al., 2007). The prevalence of stress among year 5 medical students ranged from 21.9% to 62.7% (Guthrie et al., 1998; Sherina et al., 2003; Yusoff et al., 2010; Zaid et al., 2007;). These facts showed that psychological distress were different depending on the stages of medical training (Yusoff et al., 2010).

Chronic exposure to stressful condition exerts negative effects on emotional, mental and physical well-being of the students. Numerous studies have revealed that persistence stressful condition associated with mental and physical health problems in medical students at various stages of their training (Aktekin et al., 2001; Firth, 1986; Guthrie et al., 1995; Miller and Surtees, 1991; Sherina et al., 2003; Zaid et. al, 2007). Studies reported an association of prolongeds psychological distress with lowered medical students' self-esteem (Silver & Glicken, 1990; Linn & Zeppa, 1984), anxiety and depression (Rosal et al., 1997; Shapiro et al., 2000), difficulties in solving interpersonal conflicts (Clark & Rieker, 1986), sleeping disorders (Niemi & Vainiomaki, 2006), increased alcohol and drug consumption (Flaherty & Richman, 1993; Newbury-Birch et al, 2000; Pickard et al., 2000), cynicism, decreased attention, reduced concentration and academic dishonesty (Liselotte et. al, 2005). It also associated with inhibition of students' academic achievement and personal growth development (Linn & Zeppa, 1984). Prolonged psychological distress was also linked with medical student suicide (Hays et al., 1996). As a result, medical students may feel inadequate and unsatisfied with their career as a medical practitioner in the future (Saipanish, 2003). It is noteworthy that many researchers stated the importance of early diagnosis as well as effective intervention programmes, that can prevent possible future mental illnesses among medical students (Aktekin et al., 2001; Firth, 1986; Sherina, 2003).

Studies revealed that the stressors affecting medical students' well being seems to be related to the medical training especially related to academic matters (Aktekin et al., 2001; Guthrie et al, 1995; Kaufman et al., 1996, 1998; Saipanish, 2003; Yusoff et al., 2011; Yusoff et al., 2010). They found that the top four stressors were tests and examinations, time pressure, too many content to be studied, and getting behind in work. Another three common stressors were conflicting demands, not getting work done within time planned and heavy workload. A small number of medical students suffer from personal problems, but the effect of this on medical students' psychological morbidity and academic success is unclear (Guthrie et al, 1995; Firth, 1986; Saipanish, 2003). Curriculum differences in medical schools may not necessarily cause differences in the overall pattern of stressors (i.e. most of the top stressors are related to academic matters), although frequency (rank) of some stressors may be significantly different (Kaufman et al., 1996, 1998).

It is worth to highlight that several medical education constituencies have emphasized the importance of teaching stress management and self-care skills to medical students (Steven et al., 2003; Susan et al., 2007). A recent literature review discovered that, although more than 600 articles addressed the importance of stress management programs in medical curricula, only 24 reported intervention programs with accompanying data; however none of the programmes provide convincing evidence of their effectiveness (Shapiro et al., 2000). Apart from that, their specific applications to medical education have been largely unexplored (Shapiro et al., 2000). Therefore a systematic review was done to evaluate the effectiveness of stress management specifically done on medical students with regard to five aspects which were 1) nature of participation, 2) research methods, 3) structure, facilitator and duration of intervention, 4) measured outcomes and instruments used to measure them and 5) outcomes of the intervention. On top of that we also categorized studies based on country.

2. Methodology

The literature search was performed using the Google Scholar, PubMed database, EbscoHost databases, Cochrane Library database, Scopus database, and Science Direct database. Keywords used in searching include 'medical student', 'stress management', 'medical student wellbeing', and 'stress intervention'. No time limit was specified in searching. Abstracts of the searched articles were read through for relevance. Participants, sampling method, study design, intervention structure, content and technique, and outcomes were the key issues of inclusion criteria for in-depth study of the full articles. Articles must describe stress management specifically for medical students otherwise they were not included in this review. Some of the articles were searched from the reference lists of the articles of primary search.

3. Results

Based on the keywords stated in the method, our search found that Google scholar database yielded over 1000 articles, Pubmed database yielded 275 articles, Cochrane Library database yielded 99 articles, EBSCO host database yielded 408 articles, Scopus database yielded 324 articles and Science Direct yielded 14 articles. However, based on abstract reading we found 28 articles fulfilled our inclusion criteria and they were selected for in-depth review. After the in-depth review 22 articles were included for review, 6 articles were excluded due to irrelevant content for current review. A new article was found from the reference list of the primary search and it was included in this current review. Approximately 23 articles were appraised and the results were summarised in tables. The earliest study was found in 1978 and the latest study was found in 2011. The earliest study was reported in 1978 (Soskis, 1978) and the latest study was reported in 2011 (Yusoff, 2011). Results of this systematic review were tabulated based on the five areas which were 1) nature of participants, 2) research methods (table 1), 3) structure, facilitators and duration of intervention (table 2), 4) measure outcomes and instrumed used to measure them (table 3) and 5) outcomes of the interventions (table 4-8).

In general, participation of the interventions were categorized into random (i.e. selection of participants were made based on random sampling method) (Mitchell et al., 1983) and non-random (i.e. selection of participants were made based on non-random sampling method such as volunteer, convenient and purposive sampling method). Majority of the studies (i.e. 22 out of 23 studies) used non-random sampling method in selecting participants (Bughi et al., 2009; Finkelstein et al., 2007; Hassed et al., 2008; Hassed et al., 2009; Holtzworth-Munroe et al., 1985; Jain et al., 2007;Kelly et al., 1982; Kiecolt-Glaser et al., 1986; Klamen, 1997; Lee & Graham, 2001; MacLaughin et al., 2010; Michie & Sandhu, 1994; Nathan et al., 1987; Rosenzweig et al., 2003; Redwood & Polak, 2007; Simard & Henry, 2009; Shapiro et al., 1998; Soskis, 1978; Whitehouse et al., 1996; Yusoff & Rahim, 2010; Yusoff, 2011; Zeitlin et al., 2000).

As shown in table 1, approximately 10 (43.48%) studies had no comparison groups (Bughi et al., 2009; Hassed et al., 2008; Hassed et al., 2009; Lee & Graham, 2001; Klamen, 1997; Redwood & Polak, 2007; Simard & Henry, 2009;; Soskis, 1978; Yusoff & Rahim, 2010; Zeitlin et al., 2000;) and 13 (56.52%) studies had comparison groups (Finkelstein et al., 2007; Holtzworth-Munroe et al., 1985; Jain et al., 2007; Kelly et al., 1982; Kiecolt-Glaser et al., 1986;

MacLaughin et al., 2010; Michie & Sandhu, 1994; Mitchell et al., 1983; Nathan et al., 1987; Rosenzweig et al., 2003; Shapiro et al., 1998; Whitehouse et al., 1996; Yusoff, 2011). Out of 13, about seven studies randomly assigned participants to control and intervention groups (Holtzworth-Munroe et al., 1985; Jain et al., 2007; Kiecolt-Glaser et al., 1986; Mitchell et al., 1983; Nathan et al., 1987; Shapiro et al., 1998; Whitehouse et al., 1996). Out of the seven randomized control studies, only one study sampled their participants randomly (Mitchell et al., 1983). Even more only two studies (Jain et al., 2007; Yusoff, 2011) clearly mentioned about sample size calculation for the intervention and comparison groups while the rest of studies had not mentioned about it. The longest follow up duration for measurement of outcomes was 12 months (Nathan et al., 1987) and the shortest follow up duration for measurement of outcomes was immediately right after the intervention completed (Klamen, 1997; Redwood & Polak, 2007; Soskis, 1978; Zeitlin et al., 2000).

Study design (frequency)	Measurement of outcomes (frequency)	Source (arranged based on year of study)	Country (frequency)
Randomized controlled trial (7)	Four times: pre (1x) and post (3x) intervention	Nathan et al (1987) and Whitehouse et al (1996).	US (7)
	Three times: pre (1x) and post (2x) intervention	Holtzworth-Munroe et al (1985), Shapiro et al (1998), Jain et al (2007)., and Mitchell et al (1983).	
	Two times: pre and post intervention	Kiecolt-Glaser et al (1986).	
Quasi-experimental: nonequivalent comparison group (6)	Three times: pre (1x) and post (2x) intervention	Michie & Sandhu (1994) and Finkelstein et al (2007).	US (4) UK (1) Malaysia (1)
	Two times: pre and post intervention	Kelly et al (1982), Rosenzweig et al (2003) and MacLaughin et al (2010).	
	Two times: post (2x) intervention	Yusoff (2011).	
Quasi-experimental: time series without comparison group (10)	Three times: pre (1x) and post (2x) intervention	Simard & Henry (2009).	US (6) Australia (2) Canada (1) Malaysia (1)
	Two times: pre and post intervention	Klamen (1997) and Zeitlin et al (2000).	
	Two times: post (2x) intervention	Lee & Graham (2001), Hassed et al (2008), Hassed et al (2009), Bughi et al (2009) and Yusoff & Rahim (2010).	
	Once: post-intervention	Soskis (1978) and Redwood & Polak (2007).	

Table 1. Summary of research design, frequency measurement of outcomes and country of the 23 studies were conducted.

Approximately 34.8% (n=8) of interventions was offered as elective course, 26.1% (n=6) was offered as a seminar/workshop, 17.4% (n=4) was offered as a specific training/therapy, 8.7% (n=2) was offered as support group, 8.7% (n=2) was offered as a program built in the core curriculum and 4.3% (n=1) was offered as a volunteer program (table 2).

Structure (frequency)	Name of intervention	Number of Participant	Facilitator	Total Duration	Source and Country
Elective course (8)	The Meditation & Healing.	42: 1st and 2nd year medical students.	A Psychiatrist and Professional teachers.	Not mentioned.	Soskis (1978), US.
	The stress management training course.	96 to 103: 1st year medical students.	Psychiatrists and Clinical Psychologist.	400 minutes over 8 weeks.	Nathan et al (1987), US.
	The stress management course.	69: 1st clinical year (3rd year) medical students	A Clinical Psychologist.	360 minutes over 3 weeks.	Michie & Sandhu (1994), UK.
	The Mindfulness Based Stress Reduction.	38: 1st and 2nd year medical students. 35: premedical students	Clinical Psychologists	1050 minutes over 7 weeks.	Shapiro et al (1998), US.
	The Help programme.	66: 1st and 2nd year medical students.	Physicians	360 minutes over 6 weeks.	Lee & Graham (2001), US.
	The Mind-Body Medicine: An Experiential Elective	32: 2nd year medical students.	Not mentioned.	1200 minutes over 10 weeks.	Finkelstein et al (2007), US.
	The Brief Behavioural Intervention Program (BPIP)	34: 3rd and 4th year medical students.	Not mentioned.	Over one month duration.	Bughi et al (2009), US.
	The Mind Body Medicine Skills.	24: 1st year medical students.	Faculty members.	1320 minutes over 11 weeks.	MacLaughin et al (2010), US.
Volunteer program (1)	Student-led stress management program	1282 (over 16 years): 1st year medical students. Average participant in a year was 80.	2nd year medical students trained and guided by two Psychologists.	420 minutes over 7 weeks.	Redwood & Polak (2007), US.
Seminar/ workshop (6)	Seminar	38: 1st, 2nd and 4th year medical students. 10: residents and nurses	Four Clinical Psychologists.	360 to 540 minutes over 3 weeks.	Kelly et al (1992), US.

Structure (frequency)	Name of intervention	Number of Participant	Facilitator	Total Duration	Source and Country
	Workshop	40: 1st and 2nd year medical students.	A Clinical Psychologist.	360 minutes over 6 weeks.	Holtzworth-Munroe et al (1985), US.
	The stress management workshop	30: 1st year medical students.	A Psychiatrist.	360 minutes over 3 weeks.	Klamen (1997), US.
	The Mindfulness Based Stress Reduction seminar	302 (1996-2000): 2nd year medical students. Average participant in a year was 60.	Not mentioned.	900 minutes over 10 weeks.	Rosenzweig et al (2003), US.
	The Medical Student Wellbeing Workshop.	34: 2nd, 3rd, 4th and 5th year medical students.	Faculty members.	240 minutes over a half-day.	Yusoff & Rahim (2010), Malaysia.
	The Medical Student Wellbeing Workshop.	48: 1st year medical students.	Faculty members.	240 minutes over a half-day.	Yusoff (2011), Malaysia.
Built in core curriculum (2)	The Health Enhancement Programme (HEP)	315: 1st year medical students.	Not mentioned	1260 minutes over half of a semester.	Hassed et al (2008), Australia.
	The Health Enhancement Programme (HEP)	148: 1st year medical students.	12 trained tutors.	1260 minutes over half of a semester.	Hassed et al (2009), Australia.
Support group (2)	Support group	38: 1st year medical students.	Two Clinical Psychologists.	400 minutes over 8 weeks.	Mitchell et al (1983), US.
	Support group	34: 1st year medical students	A Clinical Psychologist.	Not mentioned.	Kiecolt-Glaser et al (1986), US.
Specific training/ therapy (4)	Self-hypnosis training	35: 1st year medical students	Two Psychiatrists	1260 minutes over 14 sessions throughout one semester.	Whitehouse et al (1996), US.
	Massage therapy	9: 1st and 2nd year medical students	Not mentioned	60 minutes one day before examination.	Zeitlin et al (2000), US.

Structure (frequency)	Name of intervention	Number of Participant	Facilitator	Total Duration	Source and Country
	Mindfulness Meditation-Somatic Relaxation	81 (divided into 3 groups which were Mindfulness, Somatic & Control): mixture of medical and allied health students.	Two mindfulness instructors and two relaxation instructors	360 minutes over 4 weeks.	Jain et al (2007), US.
	Yoga exercise	16: 1st year medical students.	A certified yoga teacher.	1920 minutes over 16 weeks.	Simard & Henry (2009), Canada.

Table 2. Summary of structure, participants, facilitator and total duration of interventions of the 23 studies were conducted.

Approximately 43.5% (n=10) of interventions was conducted by Psychologist/Psychiatrist, 13% (n=3) by trained instructor, 13% (n=3) by faculty member, 4.3% (n=1) by medical student, 4.3% (n=1) by physician and 21.7% (n=5) was not reported (table 2).

The shortest duration of intervention was 60 minutes as massage therapy over an afternoon (Zeitlin et al., 2000) and the longest duration of intervention was 1920 minutes (32 hours) over a 16-week yoga exercise (Simard & Henry, 2009). However majority of intervention (n=9) utilised 360 to 540 minutes over 3 to 8 weeks (table 2).

The smallest and biggest number of participants involved in an intervention were 9 (Zeitlin et al., 2000) and 315 (Hassed et al., 2008) respectively. However, majority of those studies (n=12) had involved 30 to 50 participants in an intervention (table 2).

Most of studies (n=11) measured participants' perception on acceptability and feasibility of stress management interventions using evaluation questionnaire at the end of the interventions (table 3). Items of the evaluation questionnaires used were different between studies depending on objectives of the interventions. Despite of the differences, this fact clearly suggested that perception of participants towards feasibility and acceptability of stress management interventions were considered as one of important outcomes of the interventions. Apart from participants' feedback on acceptability and feasibility of the interventions, there were three other most common measured outcomes that were considered as major indicators of effectiveness of stress management interventions regardless of its types which were anxiety (n=14), depression (n=13) and psychological distress (n=10) as shown in table 3. Majority of studies (n=7) measured anxiety level among participants using the State-Trait Anxiety Inventory (STAI) followed by the Brief Symptom Inventory (BSI) (n=3), the Anxiety Subscale of Symptom Checklist Revised (n=2), The Depression Anxiety Stress Scale (n=1) and other inventories (table 3). Depressive symptoms were mostly measured by the Brief Symptom Inventory (BSI) (n=3) and the Depression Subscale of Symptom Checklist Revised (n=3) followed by the Beck Depression Inventory (n=1), the Depression Anxiety Stress Scale (n=1) and others inventories (table 3).

Outcomes Measured (frequency)	Instrument (frequency)	Source
Students' perception on feasibility and acceptability of intervention (11)	Evaluation Questionnaire (11)	Soskis (1978), Nathan et al (1987), Michie & Sandu (1994), Klamen (1997), Shapiro et al (1998), Lee & Graham (2001), Rosenzweig et al (2003), Redwood & Polak (2007), Hassed et al (2008), Simard & Henry (2009), Yusoff & Rahim (2010).
	Interview (1)	Soskis (1978).
	Essay (1)	Lee & Graham (2001).
Psychological Distress (10)	Rating scales of the frequency and intensity of weekly tension and depression (1)	Holtzworth-Munroe et al (1985),
	Social Readjustment Rating Scale (1)	Nathan et al (1987),
	Distress subscale of Symptom Checklist Revised (SCL-90R) (2)	Shapiro et al (1998), Hassed et al (2008),
	Visual Analogue Perceived Stress (1)	Zeitlin et al (2000),
	Perceived Stress of Medical School (1)	Finkelstein et al (2007),
	General Health Questionnaire 12 item (2)	Simard & Henry (2009), Yusoff & Rahim (2010)
	Perceived Stress Scale (1)	Simard & Henry (2009),
	Saliva Cortisol Level (1)	MacLaughin et al (2010)
	Saliva Dehydroepiandrosterone-sulfate (DHEA-S) level (1)	MacLaughin et al (2010)
	Saliva Testosterone level (1)	MacLaughin et al (2010)
	Saliva Secretory Immunoglobulin A (sIgA) level (1)	MacLaughin et al (2010)
	Depression Anxiety Stress Scale 21-item (1)	Yusoff (2011)
Anxiety (14)	State-Trait Anxiety Inventory (7)	Kelly et al (1982), Mitchell et al (1983), Holtzworth-Munroe et al (1985), Nathan et al (1987), Michie & Sandu (1994), Shapiro et al (1998), Zeitlin et al (2000),
	Rating Scales of Anxiety and Intensity in Test and Social Situation (1)	Holtzworth-Munroe et al (1985),
	Brief Symptom Inventory (3)	Kiecolt-Glaser et al (1986), Whitehouse et al (1996), Jain et al (2007).
	7 Questions covered on anxiety, depression and satisfaction (1)	Michie & Sandu (1994).
	Anxiety subscale of Symptom Checklist Revised (SCL-90R) (2)	Finkelstein et al (2007), Hassed et al (2009).
	Anxiety subscale of General Well Being Scale (1)	Bughi et al (2009).
	Depression Anxiety Stress Scale 21-item (1)	Yusoff (2011).

Outcomes Measured (frequency)	Instrument (frequency)	Source
Depression (13)	Beck's Depression Inventory (1)	Mitchell et al (1983).
	Rating scales of the frequency and intensity of weekly tension and depression (1)	Holtzworth-Munroe et al (1985).
	Brief Symptom Inventory (3)	Kiecolt-Glaser et al (1986), Whitehouse et al (1996), Jain et al (2007).
	Depression Adjective Checklist (1)	Nathan et al (1987).
	7 Questions covered on anxiety, depression and satisfaction (1)	Michie & Sandu (1994).
	Depression subscale of Symptom Checklist Revised (SCL-90R) (3)	Shapiro et al (1998), Hassed et al (2008), Hassed et al (2009).
	2-item Depression Index (1)	Finkelstein et al (2007).
	The Center of Epidemiologic Studies Depression (CES-D) scale (1)	Simard & Henry (2009).
	Depression subscale of General Well Being Scale (1)	Bughi et al (2009).
	Depression Anxiety Stress Scale 21-item (1)	Yusoff (2011).
Loneliness (3)	UCLA Loneliness scale (3)	Kiecolt-Glaser et al (1986), Nathan et al (1987), Whitehouse et al (1996).
Mood state (3)	Profile of Mood States (POMS) (3)	Whitehouse et al (1996), Rosenzweig et al (2003), Finkelstein et al (2007).
Quality of life (2)	WHOQOL (2)	Hassed et al (2008), Hassed et al (2009)
Type A behaviour (2)	Jenkins Activity Schedule (2)	Kelly et al (1982), Nathan et al (1987)
	Bortner's short rating scale of Type A behaviour (1)	Nathan et al (1987)
Physiologic & Immunologic Health marker (3)	Helper/Inducer T Lymphocytes (2)	Kiecolt-Glaser et al (1986), Whitehouse et al (1996)
	Suppressor/Cytotoxic T Lymphocytes (2)	Kiecolt-Glaser et al (1986), Whitehouse et al (1996)
	Total Iron-Binding Protein (TIBC) (1)	Kiecolt-Glaser et al (1986),
	Transferrin (1)	Kiecolt-Glaser et al (1986),
	Albumin (1)	Kiecolt-Glaser et al (1986),
	Natural Killer Cell (NK-cell) (3)	Kiecolt-Glaser et al (1986), Whitehouse et al (1996), Zeitlin et al (2000)
	B Lymphocytes (1)	Whitehouse et al (1996)
	Monocytes (1)	Whitehouse et al (1996)
	Granulocytes	Whitehouse et al (1996)
	Total White Blood Count (1)	Zeitlin et al (2000),
	Mitogen-Induced Lymphocyte Stimulation (1)	Zeitlin et al (2000)

Outcomes Measured (frequency)	Instrument (frequency)	Source
	Respiratory Rate (1)	Zeitlin et al (2000)
	Blood Pressure (1)	Zeitlin et al (2000)
	Body Temperature (1)	Zeitlin et al (2000)
	Pulse Rate (1)	Zeitlin et al (2000)
Spiritual Experience (2)	INSPIRIT (2)	Shapiro et al (1998), Jain et al (2007)
Empathy (1)	Empathy Construct Rating Scale (1)	Shapiro et al (1998)
General Wellbeing (1)	General Well Being Scale (1)	Bughi et al (2009)
Academic performance (3)	Grade Point Average (3)	Mitchell et al (1983), Kiecolt-Glaser et al (1986), Nathan et al (1987).
Positive Psychological State (1)	Positive States of Mind Scales (1)	Jain et al (2007)
Self-esteem (1)	A Self-Esteem Measure (1)	Holtzworth-Munroe et al (1985)
Personality (3)	Minnesota Multiphasic Personality Inventory (2)	Mitchell et al (1983), Nathan et al (1987),
	16 Personality Factor Test (1)	Kiecolt-Glaser et al (1986)
Distractive & Ruminative thought (1)	Daily Emotion Report (1)	Jain et al (2007)
Knowledge of stress & its management (1)	Stress Knowledge Inventory (1)	Kelly et al (1982)
Perceived stressors (2)	Stressful Situations Rating (1)	Kelly et al (1982)
	Hassles Scale (1)	Nathan et al (1987)
Intrinsic & Extrinsic Satisfaction (1)	7 Questions covered on anxiety, depression and satisfaction (1)	Mitchie & Sandu (1994)
Quality of sleep (1)	Daily Dairies (1)	Whitehouse et al (1996)
Hypnotic ability (1)	The Harvard Group Scale of Hypnotic Susceptibility (1)	Whitehouse et al (1996)
	The Inventory of Self-Hyonosis (1)	Whitehouse et al (1996)
Preferred specialty choice (1)	Questionnaire on procedural and non-procedural specialty (1)	Klamen (1997)
General Health Status (2)	Self-Reporting questionnaire (1)	Kiecolt-Glaser et al (1986),
	Health Chart (1)	Nathan et al (1987)
	Duke-UNC Health Profile (1)	Nathan et al (1987)

Table 3. Summary of measured outcomes and instruments used to measure them.

Psychological distress level was measured by mostly by General Health Questionnaire 12-item (n=2) and the Distress Subscale of Symptom Checklist Revised (n=2) followed by the Depression Anxiety Stress Scale (n=1) and other inventories (table 3).

Despite of the four most common measured outcomes (i.e. students' perception, anxiety, depression and psychological distress), they were other important outcomes to be considered in future research such as loneliness (n=3), mood states (n=3), academic performance (n=3), health biomarkers (n=3), quality of life (n=2) and general wellbeing (n=1) (table 3).

Outcomes of interventions were summarized based on five categories which were brief intervention (less than 2 days), short-duration intervention (2 days to 4 weeks), medium-duration intervention (more than 4 weeks and up to 8 weeks), long-duration intervention (more than 8 weeks) and other (duration was not mentioned in the articles).

There were three brief interventions reported by previous studies (table 4) and all of them had significant positive impacts on psychological health of medical students (table 4). The massage therapy improved immunologic and physiologic health marker (Zeitlin et al., 2000). While the Medical Student Wellbeing Workshop improved awareness of participants about stress, its effect and management as well as a well-accepted intervention by participants (Yusoff & Rahim, 2010).

Source and Country	Name of intervention	Outcome	Summary of outcome (n)
Zeitlin et al (2000), US.	Massage therapy	- Reduced respiratory rate - Decreased anxiety state. - Decreased perceived stress - Decreased percentage of T Lymphocyte cells post intervention - Increased natural killer cell activity post intervention.	- Improved psychological health (3) - Improved immunologic health marker (1) - Improved physiologic health marker (1) - Increased awareness about stress, its effect and management (1) - Well accepted intervention (1)
Yusoff & Rahim (2010), Malaysia.	The Medical Student Wellbeing Workshop	- Reduced distress symptoms. - Well accepted intervention. - Rated as highly useful and successful intervention. - Increased awareness about stress, its effect and management.	
Yusoff (2011), Malaysia.	The Medical Student Wellbeing Workshop	- Reduced anxiety level - Reduced depressive symptoms. - Reduction of distress symptoms. - Sustainability of those effects	

Table 4. Outcomes of brief stress management intervention (required duration of less than 2 days)

Five short-duration interventions were reported by previous studies (table 5). About three interventions were reported to have significant positive impacts on psychological health of medical students (Bughi et al., 2009; Jain et al., 2007; Michie & Sandhu, 1994) whereas other outcomes were different from each intervention (table 5). Nevertheless, these facts had provided evidence of positive impacts of short-duration intervention on medical students' psychological health, awareness and general wellbeing.

There were six medium-duration interventions reported and most of them were well accepted by medical students as well as increased awareness of the students about handling

Source and Country	Name of intervention	Outcome	Summary of outcome (n)
Kelly et al (1982), US.	Seminar	- Reduction of type A behaviour pre and post intervention. - Increased knowledge about stress, its effect and management. - Reduced stressful intensity perception of stressful events. - No measureable of anxiety state.	- Improved psychological health (3) - Increase awareness on stress, its effect and management (2) - Well accepted intervention (2) - Increased knowledge on stress, its effect and management (1) - Reduced stressful perception toward stressor (1) - Increased self-satisfaction (1) - Influenced career choice (1) - Enhanced positive state of mind (1) - Reduced negative positive state of mind (1) - Reduced ruminative and distractive though (1) - Increased positive wellbeing (1)
Michie & Sandhu (1994), UK.	The stress management course	- Increased intrinsic and extrinsic satisfaction. - Positive perception towards the intervention. - Increase awareness on stress, its effects and management. - Reduction of anxiety and depression symptoms pre and post intervention.	
Klamen (1997), US.	The stress management workshop	- Well accepted course. - Increased interest to consider a career in psychiatry. - The intervention was very helpful in providing insight about stress and health.	
Jain et al (2007), US.	Mindfulness Meditation-Somatic Relaxation	- Reduced ruminative thought and behaviour. - Reduced distractive thought and behaviour. - Reduced psychological distress symptoms. - Enhanced positive state of mind. - Reduced negative psychological state	
Bughi et al (2009), US.	The Brief Behavioural Intervention Program (BPIP)	- Decreased anxiety level. - Increased positive wellbeing score. - No measureable effect on depression, self-control, vitality and general health. - Reduced prevalence of reported stress post intervention.	

Table 5. Outcomes of short-duration stress management intervention (required duration of 2 days to 4 weeks)

stress (table 6). However other outcomes were different from each intervention. Among the interventions, the Mindfulness Based Stress Reduction demonstrated very positive impacts on medical students' psychological health, empathy and spirituality (Shapiro et al., 1998). Nonetheless, these facts had provided evidence of positive impacts of the medium-duration intervention on medical students' psychological health, empathy, spirituality, awareness related to handling stress as well as general wellbeing (table 6).

Source and Country	Name of intervention	Outcome	Summary of outcome (n)
Mitchell et al (1983), US.	Support group	- No measureable effect on academic performance. - No measureable effect on anxiety or depression level. - No measureable effect of stress symptomatology. - No measureable effect on personality.	- Well accepted intervention (5) - Increased awareness on stress, its effect and management (3). - Reduced type A behaviour (1) - Improved psychological health (1). - Increased empathy (1) - increased spirituality feeling (1)
Holtzworth-Munroe et al (1985), US.	Workshop	- Increased awareness about stress, its effect and management - Positive perception toward the intervention. - No measureable effect on anxiety, depression and self-esteem.	
Nathan et al (1987), US.	The stress management training course	- Reduced hard-driving scale score of type A behaviour. - Positive perception towards the intervention. - No measureable effects on academic performance, general health, personality, stress symptoms, depression, anxiety, stressful intensity perception of stressor, and loneliness.	
Shapiro et al (1998), US.	The Mindfulness Based Stress Reduction	- Well accepted intervention evidence by high rate completion. - Reduced in depressive symptoms. - Reduced anxiety state. - Increased in empathy - Increased in spirituality feelings. - Reduced in psychological distress symptoms.	
Lee & Graham (2001), US.	The Help programme	- Positive feedback and well accepted intervention. - Increased insight about the need for self-care. - Increased awareness about stress, its effect and management.	
Redwood & Polak (2007), US.	Student-led stress management program	- Well accepted as attendance rated more than 85%. - Useful and valuable intervention. - Increased stress management skills.	

Table 6. Outcomes of medium-duration stress management intervention (required duration of more than 4 weeks and up to 8 weeks).

There were seven long-duration interventions reported and most of them had significant positive effects on psychological health of medical students as well as they were well accepted by the students (table 7) while other outcomes were varied from each intervention ranging from increased awareness about stress management and it's important to improved immunologic health markers. Among these interventions, the Mind Body Medicine Skills

showed very good impacts on medical students' stress biomarkers such as Cortisol, DHEA-S and testosterone (MacLaughin et al., 2010). In general, the outcomes of these interventions were related to improvement of psychological health, stress biomarkers, immunologic health marker, awareness about stress and its management, and general wellbeing (table 7).

Source and Country	Name of intervention	Outcome	Summary of outcome (n)
Whitehouse et al (1996), US.	Self-hypnosis training	- Reduction of anxiety level during examination period. - Improved quality of sleep. - No measureable effect on loneliness state. - Lowered number of T Lymphocyte at the late semester. - Lowered stressful intensity perception towards stressful events.	- Improved psychological health (5) - Well accepted intervention (3) - Increase awareness on stress, its effect and management (2). - Improved sleep quality (1) - Improved immunologic health marker (1) - Reduced stressful perception toward stressor (1) - Improved quality of life (1) - Reduced hostility (1) - Improved stress biomarkers (1) - Improved mood disturbances (1)
Rosenzweig et al (2003), US.	The Mindfulness Based Stress Reduction seminar	- Reduction of tension-anxiety, fatigue-inertia and confusion-bewilderment scores. - Increased vigor-activity scores. - Improved psychological health. - Rated as a very helpful intervention. - Increased insight about their stresses. - Increased confidence in handling stressful situations.	
Finkelstein et al (2007), US.	The Mind-Body Medicine: An Experiential Elective	- Reduction of anxiety level - No measureable effect on mood state, depressive symptoms and perceived stress - Developed skills that allow coping effectively with stressful situations.	
Hassed et al (2008), Australia.	The Health Enhancement Programme (HEP)	- Well accepted intervention. - Rated as useful intervention. - Reduced depression, anxiety and hostility during stressful period. - Improved quality of life.	

Source and Country	Name of intervention	Outcome	Summary of outcome (n)
Hassed et al (2009), Australia.	The Health Enhancement Programme (HEP)	- Reduced depressive symptoms - Reduced hostility scale. - Improved psychological distress symptoms. - No measureable effect on anxiety - Improved psychological domain quality of life. - No measureable effect on physical domain of quality of life.	
Simard & Henry (2009), Canada.	Yoga exercise	- Reduced distress symptoms. - Reduced perceived stress. - No measureable effect on depression. - Rated as beneficial intervention.	
MacLaughin et al (2010), US.	The Mind Body Medicine Skills.	- Lower change in Cortisol level - Lower morning Cortisol, DHEA-S and testosterone levels - Lower evening Cortisol level DHEA-S and testosterone levels - No measurable effect on sIgA level. - These facts suggested that intervention seem to be protected from the significant increased levels of Cortisol, DHEA-S and testosterone during stressful period.	

Table 7. Outcomes of long-duration stress management intervention (required duration of more than 8 weeks).

There were two interventions reported under other category. In general the outcomes of these interventions were related to improvement of psychological health, general wellbeing and awareness about coping strategies (table 8).

Source and Country	Name of intervention	Outcome	Summary of outcome (n)
Soskis (1978), US.	The Meditation & Healing	- increased interest to practice meditation as coping method. - increased interest to share meditation practice with patients.	- Increased awareness about coping strategies (1) - Improved psychological health (1) - Reduced loneliness state (1)
Kiecolt-Glaser et al (1986), US.	Support group (hypnotic/ relaxation exercise)	- Reduction of anxiety level between groups. - Reduction of loneliness pre and post intervention. - No measureable effect on academic performance. - No measureable effect on personality score. - No measureable effect on immunologic health martkers.	

Table 8. Outcomes of other stress management intervention (duration was not mentioned in the articles).

Study design (frequency)	Intervention Group size [n1]	Control Group size [n2]	Total participant [n1 + n2]/ total sample size [N]	Response rate	Source
Randomized controlled trial (7)	1st study (year 1 medical students 1979/1980) 1st group = 12 2ns group = 7	1st study (year 1 medical students 1979/1980) Lecture group = 13 No Rx group = 13	1st study 38/99	1st study 38.38%	Mitchell et al (1983)*
	2nd study (year 1 medical students 1980/1981) 1st group = 4 2nd group = 4	2nd study (year 1 medical students 1980/1981) Lecture group = 8 No Rx group = 8	2nd study 29/99	2nd study 29.29%	
	Intervention group = 15 year 1 medical students	No Rx group = 9 year 1 medical students	24/40	72.5%	Holtzworth-Munroe et al (1985)**
	Hypnotic/relaxation group = 17 year 1 medical students	Waiting list control group = 17 year 1 medical students	34/34	100%	Kiecolt-Glaser et al (1986)**

Study design (frequency)	Intervention Group size [n1]	Control Group size [n2]	Total participant [n1 + n2]/ total sample size [N]	Response rate	Source
	1st study (year 1 medical students 1983) Intervention group = 50 2nd study (year 1 medical students 1984) Intervention group = 49	1st study (year 1 medical students 1983) No Rx group = 46 2nd study (year 1 medical students 1984) No Rx group = 54	1st study 96/100 2nd s tudy 103/103	1st study 96% 2nd study 100%	Nathan et al (1987)**
	Intervention group = 21 year 1 medical students	Waiting list control group = 14 year 1 medical students	35/35	100%	Whitehouse et al (1996)**
	Intervention group = 36 (mixed of premedical, year 1 and 2 medical students)	Waiting list control group = 37 (mixed of premedical, year 1 and 2 medical students)	73/78	93.58%	Shapiro et al (1998)**
	Medidation group = 27 (mixed of medical and allied health students) Relaxation group = 24 (mixed of medical and allied health students)	Waiting list control group = 30 (mixed of medical and allied health students)	81/104	77.88%	[1]Jain et al (2007)**

* Random sampling method ** Non-random sampling method [1]Sample size was calculated

Table 9. Summary of sample size of intervention and control groups for the randomized control trial studies.

For randomized control trial (RCT) studies (table 9), the smallest and biggest number of participants in an intervention were 4 and 50 respectively. The smallest and biggest number of participants in a control group were 4 and 54 respectively. Majority (n=6) of the RCT studies involved year 1 medical students as study subjects. The response rate for non-random sampling RCT studies (n=6) ranged from 72.5% to 100%. While the response rate for random sampling RCT study (n=1) ranged from 29.29% to 38.38%. It seems that response rate for random sampling RCT study substantially poorer than non-random sampling RCT studies. On top of that, only one RCT calculated sample size.

4. Discussion

Without time limit, the literature search yielded 23 relevant articles reported on the effectiveness of stress management interventions on medical students. The earliest study was reported in 1978 (Soskis, 1978) and the most recent study was reported in 2011 (Yusoff, 2011). This section discussed on the effectiveness of those interventions with regards to five aspects which were 1) nature of participation, 2) research methods, 3) structure, facilitators and duration of intervention, 4) measured outcomes and instruments used to measure them, and 5) outcomes of the interventions.

In 2000, there were 15 studies reported stress reduction interventions on medical students (Shapiro et al., 2000) and in this present literature review there were 23 studies reported on the interventions (i.e. 11 years after Shapiro et al (2000) systematic review, only 8 additional studies were reported on stress management interventions for medical students). These facts suggested that despite large number of articles criticized on the negative impacts of stress related to medical training on medical students and call for remedies to buffer the unwanted consequences yet very few have put on effort to study on specific effects of stress management interventions on medical students (Shapiro et al., 2000). Even fewer studies have provided convincing data on the effectiveness of stress management interventions on medical students' health. Therefore, now is the right moment for medical educators to put more effort to expand the body of evidence on effective interventions in buffering the negative consequences of stress related to medical training on medical students (Butterfield, 1988; Shapiro et al., 2000).

4.1 Nature of participation

This systematic review clearly showed that the biggest limitation of the reported studies was related to sampling method of the participants which was non-randomized. As a result, voluntary nature of participation to the interventions was more likely to attract students who were highly motivated to change and thus more sensitive to any intervention done; this may lead to inaccuracy of outcomes measured. Nevertheless, logically having students voluntarily participating in the intervention may be more practical and feasible (Finkelstein et al., 2007). Perhaps, random sampling method in selecting participants of stress management interventions should be considered in future research to minimise bias due to volunteer participation. Therefore more authentic and convincing outcomes could be measured.

4.2 Research methods

This systematic review clearly showed that very few studies used robust study designs in investigating impact of stress reduction interventions on medical students and all of them were conducted in United State (US) as shown in the table 1. Although, Shapiro et al (2000) recommended in previous literature review to incorporate rigorous study design such as randomized control trial, unfortunately this recommendation has not been addressed where 11 non-randomized studies were done whereas only one randomized control trial was done post-recommendation (table 1). A possible reason for researchers preferred to conduct non-randomized experimental studies instead of randomized control trial may be due to issues

related ethical, feasibility and practicality of randomizing participants into intervention and control groups (Finkelstein et al., 2007; Piaw, 2009; Katz, 2010).

4.3 Structure, facilitators and duration of intervention

This systematic review demonstrated that majority of interventions was conducted by psychologist/psychiatrist, offered as an elective course as well as seminar or workshop, consumed a duration of 360 to 540 minutes over 3 to 8 weeks and involved 30 to 50 participants. For RCT studies, majority involved year 1 medical students as study subjects, sample size for intervention groups ranged from 4 to 50 participants and relatively RCT used random sampling method had poorer response rate compared to non-random sampling (table 9). Perhaps stress management interventions should be conducted by general faculty members of medical schools instead of few experts so that the interventions can be implemented effectively to medical students. On top of that, most of the studies had not explained theoretical basis of the intervention was designed. Perhaps, future studies should describe the theoretical basis of stress management intervention was designed so that researchers could compare and come out with more effective intervention based on more robust theory of stress management intervention for medical students. It is worth highlighted that generally the interventions were categorised into brief, short-duration, medium-duration and long-duration stress management internvetions.

4.4 Measured outcomes and instruments used to measure them

This review revealed that various aspects of health outcomes were measured ranging from students' perception up to health biomarkers. Despite the variability of measured outcomes, there were three main outcomes related to psychological health as measured by most of the studies which were anxiety, depressive and psychological distress symptoms. These outcomes were mainly measured by established psychological health measurements such as the State-Trait Anxiety Inventory, Brief symptoms Inventory, Symptoms Checklist Revised, Depression Anxiety Stress Scale and Beck Depression Inventory. Other important outcomes that should be considered in future researches such as academic performance, patient-doctor relationship, loneliness state, health biomarkers, quality of life, and suicidal thoughts.

4.5 Outcomes of the interventions

For the past 24 years, regardless of the duration of stress management interventions, this literature review revealed the interventions done on medical students had important positive outcomes on several areas related to health. The outcomes ranged from positive students feedback up to improvement of health biomarkers. The reported positive outcomes were related to 1) positive student feedbacks, 2) improved psychological health, 3) improved loneliness and mood disturbances, 4) improved physiologic and immunologic health markers, 5) improved quality of life, spirituality, and empathy, 6) improved psychological states of mind, 7) increased awareness about stress, its effects and management, and 8) improved perceived ability to cope effectively and positively. Despite of these positive outcomes, none of studies demonstrated effectiveness of the interventions

on clinical competencies, professionalism, doctor-patient relationships, attrition and suicidal thoughts. Perhaps these outcomes should be investigated in future researches.

5. Conclusion

This systematic review found that stress management interventions done on medical students were well-accepted and had important positive outcomes on several areas related to health. Despite these encouraging outcomes several limitations should be considered for future research which are (1) longer duration of follow up measurement on intended outcomes, (2) more robust research method, including proper sample size calculation, random sampling of subjects, randomised allocation of subjects to intervention group and comparable control group, (3) comparing impacts of intervention on different stages of medical training, (4) customized and personalized stress management, (5) investigate the impacts of stress management on professionalism, doctor-patient relationship and patient care in future, and (6) specify the theoretical basis of stress management was developed.

The implications of this review are significant on a few areas that might be worthwhile for further research. Future research must look at impacts of different duration and frequency of stress management interventions on students' health, personal and professional development; therefore optimal duration and frequency of these interventions to produce positive impacts can be determined. It is also worthy to explore which components of these interventions produce therapeutic effects and which are more effective. On top of that, future research must look at which of these interventions work best to which group of students, therefore personalized and customised stress management interventions can be designed accurately and effectively. Last but not least, future research must utilise rigour and robust research methodology to elicit real impacts of stress management interventions. Perhaps, the implications discussed in this review are not only confined to medical students, but it can be also utilised by researchers of other disciplines as a guideline to design, plan and conduct similar researches in their own setting. Utilization of similar health measurements for outcomes comparison in future researches is recommended.

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