Abstract

It is generally accepted that physical activity has a multitude of health benefits. Despite this, inactivity remains a national issue both in the UK and world-wide. Nurses have an important health promotion role in advocating the potential benefits of PA to the general public. However, research suggests that nurses may not be getting enough PA themselves, despite the active nature of the job. A vast array of potential reasons for this exist, one being the lack of value that PA may have beyond its health benefits. The purpose of this article is to provide an evidence-based review of literature on the potential of increased PA improving the wellbeing of nurses. While it is recognised that PA may benefit various indicators of wellbeing, this article provides evidence pertaining to three of the most significant influencers of wellbeing; feeling states (affect, mood and emotion), depression, and sleep.

Introduction

Physical activity (PA) is any bodily movement produced by skeletal muscles that requires energy expenditure (Biddle *et al*., 2015). This is diametrically opposed to inactivity (the relative absence or lack of movement) and contrasted with sedentary behaviour (sitting or lying during waking hours) (Biddle *et al*., 2015; Caspersen *et al*., 1985). Physical activity includes sub-components such as exercise (a more structured and repetitive form of movement with the objective of increasing physical fitness) and sport (a rule governed, structured and competitive form of activity that uses gross motor movement) (Biddle *et al*., 2015; Caspersen *et al*., 1985). Therefore, it encapsulates various types of human activity that take people beyond resting metabolic rate.

There is substantial evidence of the multifaceted benefits of PA. Much of that evidence has outlined the potential for PA to improve health-related factors such as cardiorespiratory fitness, muscular fitness and bone health, while reducing the risk of non-communicable diseases such as coronary heart disease and type 2 diabetes (Department of Health and Social Care, 2019; Reiner *et al*., 2013). The World Health Organisation (WHO) state that such benefits can be achieved by meeting a prescribed guidelines for the dosage of PA. These guidelines state that adults between the ages of 18-64 should do: at least 150 minutes of moderate-intensity aerobic PA throughout any given week, or at least 75 minutes of vigorous-intensity aerobic PA, or an equivalent combination of moderate- and vigorous-intensity activity (WHO, 2020). This is in addition to strength building and balance improving exercise at least two days a week.

Physical inactivity and the nurse agenda

Despite clear guidance, and evidence of the benefits of PA, inadequate amounts of physical inactivity remain a significant global issue (Hallal *et al*., 2012; WHO, 2020). In the UK for example, an average of 39% of adults engage in an inadequate amount of PA, which costs the NHS approximately £7.4 billion pounds a year (NICE, 2018; NHS, 2016). Thus, it is understandable that increasing PA levels is, and has been, a national agenda for over a decade (Biddle *et al*., 2015).

The nursing workforce has an important role in this agenda and should be considered key agents of change (Blake *et al*, 2017). Nurses have good quality contact time with patients, enabling the development of rapport, and allows more opportunities to offer advice on lifestyle choices that may contribute to health problems, such as inadequate PA (Ross *et al*., 2017). Furthermore, the rapport and familiarity that has been built can increase the receptiveness of any advice offered

by nurses (Blake *et al*., 2017; Blaber, 2005). However, the PA levels of nurses themselves are increasingly considered of great importance too (Blake *et al*., 2011; Blake and Harrison, 2013; Hawker, 2012).

The most obvious reason for this is that nurses face the same health-related concerns as the population they serve (Perry *et al*., 2015), so inadequate PA levels by nurses could further contribute to the burden on the NHS. The PA of nurses is also of interest because it may impact their effectiveness as professional healthcare providers. Previous research has found that the health of medical staff, such as nurses, can have a direct impact on the quality of care provided to patents (Healy and McSharry, 2010; Eposito and Fitzpatrick, 2011). This is because it may impact; health-related productivity (Letvak *et al*., 2013), absenteeism (Blake and Harrison, 2013) and the longevity of employment, thus the pool of experience available to the profession (Perry *et al*., 2015). Furthermore, patients are more likely to deem healthcare providers as credible, thus follow their advice, if they are perceived to follow their own health promotion advice such as remaining active and exercising regularly (Lobelo *et al*., 2009; Fie *et al*., 2013; Blake *et al*., 2017). This means that it can impact credibility and the ability to deliver effective and quality care (Perry *et al*., 2015). For these reasons previous research has asked the important question, are nurses suitably physically active? Or in other words, do nurses 'practice what they preach'?

Nurses have various advantages which ought to encourage participation in health-related behaviours like PA. This includes being well educated, particularly on health and wellbeing, while having the socio-economic advantage of employment, which may enhance the availability, choice and feasibility of PA pursuits (Perry *et al*., 2015). However, such benefits do not always translate into the lifestyle choices of nurses (Blake *et al*., 2017; Bakshi *et al*., 2015). On the contrary there

is evidence that a significant proportion of nurses do not get enough PA (Kumbrija *et al*., 2007), and some studies have found that as many as 50% (e.g. Albert *et al*., 2014; Tucker *et al*., 2010; Blake and Harrison 2013), to 70% (e.g. Nahm *et al*., 2012) of nurses are not sufficiently active. Considering such evidence, the purpose of this article is to encourage further participation by providing an evidence-based overview of how PA may positively contribute to the wellbeing of nurses, focusing less on the commonly discussed physiological benefits, and more on some of the psychological benefits of PA.

Psychological Benefits of Physical Activity

When its benefits are considered purely in relation to the prevention of disease, PA can be viewed as little more than a way to add years to an individual's life (Biddle *et al*., 2015). However, PA has been associated with health and wellbeing outcomes beyond the pathogenic and clinical focus of protection against disease. Research consistently outlines the role of PA in yielding "statistically significant, clinically meaningful improvements in wellbeing and quality of life outcomes" (Focht, 2012, p.110). This includes enhanced subjective wellbeing, increased life satisfaction and reductions in the symptoms of anxiety and depression (Ekkekakis, 2013; Elavsky *et al*., 2005). Therefore, there is strong evidence that PA is not just a way to add more years to a person's life, but also a way to add more life to a person's years.

The 'life' added to one's years is typically explained in relation to psychological concepts like psychological wellbeing, global wellbeing, life satisfaction, quality of life and health related quality of life. These terms are interlinked, but inconsistently defined and the subject of much debate (Karimi and Brazier, 2016). It is not the purpose, neither is it within the scope of this article to enter this debate. Consequently, in considering the benefits of PA, these terms will be conjoined under the global heading of wellbeing, and wellbeing will be considered a broad term

to explain objective and subjective factors of healthy human functioning that impact: self-acceptance, positive relationships, autonomy, environmental mastery, personal growth and sense of purpose (Karimi and Brazier, 2016; Hawker, 2012).

It is important to note the multiplicity of psychological benefits of PA which may directly or indirectly improve wellbeing. For example, regular strength and aerobic exercise can lead to significant improvements in cognitive functioning and a slowing of mental decline in older adults (Dishman *et al*., 2013; Colcome and Kramer, 2003). Similarly, there is a small but significant relationship between PA and self-esteem, which can improve wellbeing by enhancing physical self-perceptions, body satisfaction and physical self-worth (Elavsky, 2010; Biddle *et al*., 2015). However, this article will focus on evidence of the role that PA may have on three of the most significant influencers of wellbeing; feeling states (affect, mood and emotion), depression, and sleep.

Affect, Mood and Emotion

Affect is the most generic, consciously accessible feeling state that one may experience (i.e. positive or negative, good or bad) (Lochner, 2016). 'Affective states' are commonly used as an umbrella term for moods and emotions to describe non reflective feeling that is not always available to consciousness (Lochner, 2016). Within this, mood is considered a global set of affective states that may or may not have originated from a clearly identifiable stimulus, and emotion a specific feeling state following a cognitive appraisal of an eliciting event that is comparatively intense, shorter in duration and has behavioural implications (Lochner, 2016; Biddle *et al*., 2015).

The notion that PA 'makes us feel good' is a common and relatively uncontroversial view (Emerson and Williams, 2015). The release of "feel-good" neurotransmitters like endorphins and serotonin are often accredited as the reason that research has found that PA is positively associated with increased feelings of happiness, and subjective wellbeing in general (Pucci *et al*., 2012). Research generally supports the notion that exercise can enhance the experience of positive affective states (Biddle, 2000; Helfer et al., 2014). However, the relationship between them is not as straightforward as is often portrayed (Emerson and Williams, 2015). Not all PA will elicit such responses. As such, research in this area has focussed on understanding the exact circumstances that elicit the strongest positive response.

Comparisons have been made between types (e.g. aerobic vs resistance), intensity (e.g. high vs low vs medium) and longevity (e.g. acute vs chronic) of exercise. In terms of activity type and intensity, results are mixed, but tend to favour low intensity aerobic exercise. After McDonald and Hodgdon's (1991) meta-analysis on exercise and mood it was concluded that aerobic fitness training can reduce feelings of tension, anger, depression, fatigue and confusion, while increasing vigour. Similarly, Arent *et al*.'s (2000) meta-analysis of 32 studies found that older adults may benefit particularly from low intensity exercise, but also when mixing elements of cardiovascular and resistance types of training. Such research has not dismissed the potential of affective benefits following higher intensity exercise, but noted that as intensity increases, so too does the risk that affective responses will cease to be pleasurable, and instead will turn to displeasure (Ekkekakis *et al*., 2005; Ekkekakis *et al*., 2011). Therefore, although high intensity exercises like High Intensity Interval Training (HIIT) are growing in popularity, their demanding nature means that they may be accompanied with less positive, and potentially negative feeling states during

and following participation (Ekkekakis and Dafermos, 2012; Ekkekakis, 2005). This is especially when the intensity is imposed, rather than self-selected (Ekkekakis *et al*., 2011).

In terms of longevity, research suggests that positive affective states occur following both a single session (acute) and sustained periods (chronic) of PA. Reed and One's (2006) analysed 158 studies on the acute effects of aerobic exercise and found a moderate but meaningful effect immediately after exercise when the individual has been taking part for up to 35 minutes at a low intensity. This is also consistent across other meta analyses (e.g. Reed and Buck, 2009). However, it is worth noting that the effect is even stronger over a sustained period of time. For example, with a 30-35-minute duration, when completed for 3-5 days per week for 10-12 weeks.

Based on such findings it can be said that the relationship between PA and feeling states is mediated by various factors such as intensity, type of activity and length of participation (Emerson and Williams, 2015; Ekkekakis, 2003; Ekkekakis *et al*., 2011). Nonetheless, there is significant evidence that by engaging in targeted bouts of exercise, one may experience positive developments to their affective states. Interestingly, such an effect is larger when pre-activity affective states are low (Reed and Ones, 2006; Biddle *et al*., 2015). This provides credence to the idea that people may be able to 'exercise themselves happy'.

Depression

Approximately 1 in 4 people in the UK experience a mental health problem such as depression and anxiety each year, and it is predicted that by 2030 depression will be the leading risk factor for life expectancy (McManus *et al*., 2009; Biddle *et al*., 2015). This is especially pertinent to nurses as Kalmbach *et al*. (2018) state that healthcare professionals often experience insalubrious environments for mental health created by long work hours, insufficient sleep, and

circadian challenging shift schedules. While there are various established forms of treatment (e.g. medication and cognitive behavioural therapy (CBT), PA has also been considered because of its potential to engender and facilitate positive affective states, social interaction, and to act as a relief/outlet for stress (Ekkekakis, 2013; Hamer *et al*., 2006).

Despite its importance, less research has been conducted on anxiety (exceptions include Wipfli *et al*., 2008; Ekkekakis *et al*., 2011), and that which has, suffers from issues of conceptual clarity (Biddle *et al*., 2015). Consequently, it is difficult to make many conclusions about the role of PA in improving anxiety. Evidence of a bi-directional relationship between PA and depression has been found by Da Silva *et al*., (2012). Their longitudinal study concluded that those who were not depressed but remained regularly active were less likely to be depressed after an eight-year follow-up than those who were not regularly active. Inversely, those who were depressed at baseline were less likely to be regularly active at the eight year follow up than those who were not depressed at baseline. Similarly, Mammen and Faulkner's (2013) seminal systematic review of 30 longitudinal studies of high methodologic quality found a significant inverse relationship between PA and follow up depression. They concluded that, "There is promising evidence that any level of PA, including low levels (e.g., walking for less than 150 minutes/week), can prevent future depression…[and]… promoting PA may serve as a valuable mental health promotion strategy in reducing the risk of developing depression" (Mammen and Faulkner, 2013, p. 649).

Such findings offer support to the notion that PA may protect people from depression. However, considerations of the severity of the issue, the complex nature of mental illness, and its potential to be contributed to by a multitude of factors have meant that the role of PA remains disputed. This is understandable given that research in this area has for some time been harmed by

inconsistency of methodological rigour, differential approaches to defining mental health issues and it has been extremely difficult to account for confounding variables such as age, genetics, socio-economic status, the existence of other physical health issues and the use of drugs (e.g. antidepressant drugs) (Biddle *et al*., 2015). This is particularly problematic in terms of research considering PA as a treatment for depression, which presents more conflicting results.

For example, studies have found that aerobic exercise that meets the public health recommended dose can reduce symptoms of depression (e.g. Dunn *et al*., 2005), and almost two decades ago findings suggested that this may yield outcomes comparable to medication (Blumenthal *et al*., 1999; Babyak *et al*., 2000). Aside from developments in medicine which may impact the applicability of such findings today, more recent research has not consistently supported such claims. Rimmer *et al*. (2012) reviewed 30 studies on the potential relationship, only including randomised control trials, and comparing exercise to standard treatment, no treatment, placebo treatment, pharmacological treatment, psychological treatment (e.g. CBT) or other active treatment in adults (aged 18 and over) with depression. On one hand they found that exercise is moderately more effective than no or placebo interventions for reducing symptoms of depression, but compared to psychological or pharmacological therapies, exercise appears to be no more effective.

Clearly, it is important that claims of the potential role of exercise to treat depression are not overstated, or promoted in place of other treatment forms (e.g. medication and CBT) without an impeccably high threshold for the evidence that would form the rationale for such a suggestions. Though this does not mean that PA cannot have any role in treating depression. Even if not used as a replacement form of treatment, PA can be used to supplement existing forms of treatment

because, “the potential benefit of advocating the use of exercise as part of the treatment for depression far outweighs the potential risk that no effect will occur” (Biddle and Mutrie, 2001, p. 219).

Sleep

Good sleep quality improves daytime functioning, life satisfaction and mental health in general, while issues with sleep length and quality are associated with poorer quality of life, and a host of physical and mental issues (Kripke *et al*., 2002; Kredlow *et al*., 2015). Considering findings that nurses are susceptible to mental health issues because of the demanding nature of the job, its long work hours and circadian challenging shift schedules (Kalmbach *et al*., 2018), improvements in sleep may be another benefit of engaging in PA.

Physical activity has often been used as a self-help intervention for managing sleep issues (Kredlow *et al*., 2015). This is largely based on the ‘common-sense’ argument that PA will exhaust the individual and lead to a desirable level of fatigue at bedtime, which would in turn assist people to sleep longer and deeper (Biddle *et al*., 2015). This claim has become more sophisticated, and there are presently a host of claims about the mechanisms through which PA may exert an influence. For example, body temperature changes (McGinty and Szymusiak, 1990), increased energy consumption/metabolic rate (Morselli *et al*., 2012), changes in mood/anxiety symptoms (Buman and King, 2010; Uchida *et al*., 2012), changes in heart rate and heart rate variability (Sandercock *et al*., 2005), and body composition change (Uchida *et al*., 2012; Kredlow *et al*. 2015).

Though there is a lack of agreement on its mechanisms, the notion that PA may improve sleep is supported by research evidence. For example, early meta-analyses in this area found that found that acute and regular exercise increases the proportion of deep sleep and total sleep time, while

also reducing the amount of time it takes to get to sleep (Kubitz, Landers, Petruzzello and Han, 1996; Youngstedt, O'Connor and Dishman, 1997; Yang *et al*., 2012). Kredlow *et al*., (2015) conducted a meta-analysis of 66 studies, with 2863 participants, on the effects of acute and chronic PA on sleep. They found strong evidence that acute exercise reduces sleep disturbance, has a small but significant effect on total sleep time, sleep latency and sleep efficiency and sleep quality. In relation to regular exercise, they found that it has a small but significant effect on total sleep time, sleep efficiency, sleep onset latency, and moderate beneficial effects on sleep quality. Such findings also showed no significant difference between aerobic vs anaerobic exercise. This suggests that nurses may experience these sleep benefits with a multitude of different types of PA.

A critical consideration is the time of the activity. Some studies have stated that exercising within a few hours of bedtime may be detrimental to sleep (Stepanski and Wyatt, 2003). Kredlow and colleagues (2015) stated that such findings were inconsistent and there remains no clear guidance on the ideal time for such activity to occur. For example, exercising less than 3h before bedtime was significantly associated with less disturbed sleep (lower wake time after sleep onset), whereas exercising 3–8h before bedtime was not. Exercising less than 3h before bedtime and greater than 8h before bedtime were significantly associated with less time spent in light sleep (stage 1 sleep), however, exercising between 3–8h before bedtime was not. Finally, acute exercise 3–8h before bedtime was significantly associated with a decrease in rapid eye movement sleep; however, less than 3h before bedtime and greater than 8h before bedtime were not. More recent evidence does not support the hypothesis that evening exercise negatively affects sleep, on the contrary, it can help sleep (Miller *et al*., 2019; Stutz *et al*., 2019). Though this is only when the exercise remains moderate and not vigorous, is not conducted less than 1 hour before bedtime

and is relatively low impact (e.g. cycling) (Kredlow *et al*., 2015; Miller *et al*., 2019; Stutz *et al*., 2019).

Conclusion

There is a substantial amount of research evidence on the potential benefits of PA which can be applied to the nursing workforce and their patients as appropriate. Of those benefits, research suggests that PA can enhance the experience of positive affective states, serve as a protective mechanism against depression, contribute towards the treatment of depression and improve both the length and quality of sleep. There are a host of psychosocial factors and mediators that may impact the experience of these benefits. They are also influenced by the characteristics of the PA itself, e.g. the time, type and regularity of the activity being conducted. Nonetheless with evidence of extensive benefits which may be experiences from so many types, intensities and levels of consistency of PA, it can be said that nurses may enjoy these wellbeing related benefits by adhering to the WHO guidelines for PA which state that at least 150 minutes of moderate-intensity aerobic PA throughout any given week, or at least 75 minutes of vigorous-intensity aerobic PA, or an equivalent combination of moderate- and vigorous-intensity activity.

References

Arent, S. M., Landers, D. M. and Etnier, J. L. (2000). The effects of exercise on mood in older adults: A meta-analytic review. Journal of Aging and Physical Activity, 8, 407-430.

Babyak, M., Blumenthal, J., Herman, S., Khatri, P., Doraiswamy, M., Moore, K., Craighead, W., Baldewicz, Teri., and Krishnan, K. (2000). Exercise Treatment for Major Depression: Maintenance of Therapeutic Benefit at 10 Months. Psychosomatic medicine, 62, 633-638.

Bakhshi, S., Sun. F., Murrells, T. and While, A. (2015). Nurses' health behaviours and physical activity-related health-promotion practices. British Journal of Community Nursing, 20, 6, 289-296.

Biddle, S. J. H. (2000) Emotion, mood and physical activity. In: S. J. H. Biddle, K. R. Fox and S. H. Boutcher (eds), Physical Activity and Psychological Well-being, pp. 63-87. London: Routledge.

Biddle, S. J. H. and Mutrie, N. (2001) Psychology of Physical Activity: Determinants, Well-being, and Interventions. Medicine and Science in Sports and Exercise, second edition. Oxford, Routledge.

Biddle, S. J. H., Mutrie, N. and Gorely, T (2015). Psychology of physical activity: Determinants, well-being and interventions, third edition. Oxford, Routledge.

Blaber A.Y (2005) Exercise: who needs it? British Journal of Nursing 14, 18, 973–975.

Blake, H. and Harrison, C. (2013) Health behaviours and attitudes towards being role models. British journal of nursing, 22, 2, 86–94.

Blake H., Malik S., Mo P. K. H. and Pisano C. (2011) 'Do as I say, but not as I do': are next generation nurses role models for health? Perspectives in Public Health 131, 5, 231–239.

Blake, H., Stanulewicz, N. and McGill, F. (2017). Predictors of physical activity and barriers to exercise in nursing and medical students. Journal of Advanced Nursing 73, 4, 917–929.

Blumenthal, J., Babyak, M., Moore, K., Craighead, W., Herman, S., Khatri, P., Waugh, R., Napolitano, M., Forman, L., Appelbaum, M., Doraiswamy, P. and Krishnan, K. (1999) Effects of Exercise Training on Older Patients with Major Depression. Archives of internal medicine 159, 2349-2356.

Buman, M. P. and King, A. C. (2010) Exercise as a treatment to enhance sleep. American Journal of Lifestyle Medicine 4, 500-514.

Caspersen, C. J., Powell, K. E. and Christenson, G. M. (1985) Physical activity, exercise and physical fitness: Definitions and distinctions for health related research. Public health reports 100, 126- 131.

Colcombe, S. and Kramer, A. (2003) Fitness Effects on the Cognitive Function of Older Adults A Meta-Analytic Study. Psychological science 14, 125-130.

Da Silva, M. A., Singh-Manoux, A., Brunner, E., Kaffashian, S., Shipley, M., Kivimäki, M. and Hermann, N. (2012) Bidirectional association between physical activity and symptoms of anxiety and depression: The Whitehall II study. European journal of epidemiology, 27, 537-546.

Department of Health and Social Care (2019). Physical Activity Guidelines: UK Chief Medical Officers' report. January 2020 [online]. https://www.gov.uk/government/publications/physical-activity-guidelines-uk-chief-medical-officers-report (Last accessed: 10 February 2020)

Dishman, R. K., Heath, G. W. and Lee, I-M. (2013) Physical Activity Epidemiology, second edition. Champaign IL: Human Kinetics.

Dunn, A. L., Trivedi, M. H., Kampert, J. B., Clark, C. G., and Chambliss, H. O. (2005) Exercise treatment for depression: Efficacy and dose response. American Journal of Preventive Medicine 28 10, 1-8.

Ekkekakis, P. (2003). Pleasure and displeasure from the body: Perspectives from exercise. Cognition and emotion 17, 213-239.

Ekkekakis, P. (2013) The Measurement of Affect, Mood, and Emotion: A Guide for Health-Behavioral Research. Cambridge: Cambridge University Press.

Ekkekakis, P., Hall E. E and Petruzzello, S. J. (2005). Variation and homogeneity in affective responses to physical activity of varying intensities: An alternative perspective on dose-response based on evolutionary considerations. Journal of Sports Sciences 23, 5, 477–500.

Ekkekakis, P., Parfitt, G., and Petruzzello, S. J. (2011) The pleasure and displeasure people feel when they exercise at different intensities: decennial update and progress towards a tripartite rationale for exercise intensity prescription. Sports Medicine 41, 641–671.

Elavsky, S.. (2010) Longitudinal Examination of the Exercise and Self-Esteem Model in Middle-Aged Women. Journal of sport & exercise psychology 32, 862-880.

Elavsky, S., McAuley, E., Motl, R. W., Konopack, J. F., Marquez, D., Hu, L., Jerome, G. J., and Diener, E. (2005). Physical activity enhances long-term quality of life in older adults: efficacy, esteem, and affective influences. Annals of Behavioural Medicine 30, 2, 138-145

Emerson, J. A. and Williams, D. M. (2015) The multifaceted relationship between physical activity and affect. Social and Personality Psychology Compass 9, 8, 419-433.

Esposito, E.M., Fitzpatrick, J.J. (2011) Registered nurses' beliefs of the benefits of exercise, their exercise behaviour and their patient teaching regarding exercise. International journal of Nursing Practice 17, 4, 351-356.

Fie, S., Norman, I. J. and While, A. (2012) The relationship between physicians' and nurses' personal physical activity habits and their health-promotion practice: A systematic review. Health Education Journal 72, 1, 102-119.

Focht, B. C. (2012) Exercise and Health related quality of life. In: E. O. Acevedo (Ed.). The Oxford Handbook of Exercise Psychology, pp.97-117. New York: Oxford University Press.

Hallal, P., Andersen, L., Bull, F., Guthold, R., and Ekelund, U. (2012) Global physical activity levels: surveillance progress, pitfalls, and prospects. The Lancet 380, 247-257.

Hamer, M., Taylor, A. and Steptoe, A. (2006) The effect of acute aerobic exercise on stress related blood pressure responses: a systematic review and meta-analysis. Biological Psychology, 71, 2, 183-190.

Hawker, C. L. (2012) Physical activity and mental well-being in student nurses. Nurse Education Today, 32, 325-331.

Healy, D. and McSharry, P (2010) Promoting self-awareness in undergraduate nursing students in relation to their health status and personal behaviours. Nurse Education Practice, 11, 4, 228-233.

Helfer, S., Elhai, J. D. and Geers, A. (2014) Affect and Exercise: Positive Affective Expectations Can Increase Post-Exercise Mood and Exercise Intentions. Annals of Behavioral Medicine 49, 2, 269-279.

Kalmbach, D., Fang, Y., Arnedt, J., Cochran, A., Deldin, P., Kaplin, A. and Sen, S. (2018) Effects of Sleep, Physical Activity, and Shift Work on Daily Mood: A Prospective Mobile Monitoring Study of Medical Interns. Journal of General Internal Medicine 33, 6, 914-920.

Karimi, M. and Brazier, J. (2016) Health, Health-Related Quality of Life, and Quality of Life: What is the Difference? PharmacoEconomics 34, 645-649.

Kredlow, M., Capozzoli, M., Hearon, B., Calkins, A. and Otto, M. (2015) The effects of physical activity on sleep: a meta-analytic review. Journal of Behavioral Medicine 38, 3, 427-449.

Kripke, D. F., Garfinkel, L., Wingard, D. L., Klauber, M. R., and Marler, M. R. (2002) Mortality associated with sleep duration and insomnia. Archives of General Psychiatry 59, 131–136.

Kubitz, K.A., Landers, D.M., Petruzzello, S.J. and Han, M. (1996) The Effects of Acute and Chronic Exercise on Sleep. Sports Medicine 21, 277–291.

Kumbrija, S., Milakovic, S.B., Jelinic, J.D., Matanic, D., Markovic, B.B. & Simunovic, R. (2007) Health care professionals attitudes towards their own health. Acta Medica Croatica 61, 1, 105-110.

Letvak, S., Ruhm, C. and Gupta, S. (2013) Differences in health, productivity and quality of care in younger and older nurses. Journal of Nursing Management, 21, 914-921.

Lobelo, F., Duperly, J. and Frank, E. (2008) Physical activity habits of doctors and medical students influence their counseling practices. British Journal of Sports Medicine 43, 89-92.

Lochner K. (2016) Successful Emotions [online]. Hamburg: Springer, Wiesbaden. Available from SpringerLink. https://www.springer.com/gp/book/9783658122300 Last accessed 10 February 2020.

Mammen, G. and Faulkner, G. (2013) Physical Activity and the Prevention of Depression: A Systematic Review of Prospective Studies. American journal of preventive medicine, 45, 649-657.

McDonald, D. G. and Hodgdon, J. A. (1991) Psychological effects of aerobic fitness training. New York: Springer-Verlag

McGinty, D., and Szymusiak, R. (1990) Keeping cool: A hypothesis about the mechanisms and functions of slow-wave sleep. Trends in Neurosciences 13, 480–487.

McManus, S., Meltzer, H., Brugha, T. S., Bebbington, P. E., and Jenkins, R. (2009) Adult psychiatric morbidity in England, 2007: results of a household survey. The NHS Information Centre for health and social care.

Miller, D. J., Sargent, C., Roach, G. D., Scanlan, A. T., Vincent, G. E. and Lastella, M. (2019) Moderate-intensity exercise performed in the evening does not impair sleep in healthy males. European Journal of Sport Science, 9, 1–10.

Morselli, L. L., Guyon, A., and Spiegel, K. (2012) Sleep and metabolic function. Pflügers Archiv 463, 139–160.

Nahm, E., Warren, J., Zhu, S. and Brown, J. (2012). Nurses' self-care behaviors related to weight and stress. Nursing Outlook 60, 5, E23-E31.

NHS Digital. (2016). Health Survey for England, 2016 - NHS Digital. [online] Available at: https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/health-survey-for-england-2016 Last Accessed 10 February 2020

NICE (2018) Overview | Physical activity and the environment | Guidance | NICE. [online] Available at: https://www.nice.org.uk/guidance/NG90. Last Accessed 10 February 2020

Perry, L., Gallagher, R. and Duffield, C. (2015) The health and health behaviours of Australian metropolitan nurses: an exploration study. BMC Nursing 14, 45 (open access).

Pucci, G., Reis, R., Rech, C. and Hallal, P. (2012) Quality of life and physical activity among adults: Population-based study in Brazilian adults. Quality of Life Research 21 1537-1543.

Reed, J. and Buck, S. (2009) The effect of regular aerobic exercise on positive activate affect: A meta-analysis. Psychology of Sport and Exercise 10, 6, 581-594.

Reed, J. and Ones, D. S. (2006) The effect of acute aerobic exercise on positive activated affect: A meta-analysis. Psychology of Sport and Exercise 7, 5, 477-514.

Reiner, M., Niermann, C., Jekauc, D. and Woll, A. (2013) Long-term health benefits of physical activity – a systematic review of longitudinal studies. BMC Public Health, 13, 1, 813-821.

Rimer, J., Dwan, K., Lawlor, D., Greig, C., McMurdo, M., Morley, W. and Mead, G. (2012) Exercise for depression. Cochrane database of systematic reviews (Online). 7. CD004366. 10.1002/14651858.CD004366.pub5. Last Accessed 10 February 2020

Ross, A., Bevans, M., Brooks, A., Gibbons, S. and Wallen, G. (2017) Nurses and Health-Promoting Behaviors: Knowledge May Not Translate into Self-Care. AORN Journal 105, 267-275.

Russell, J.A, and Feldman Barrett, L. (2009) Core affect. In: D. Sander & KR Scherer (Eds), The Oxford companion to emotion and the affective sciences (p. 104). New York: Oxford University Press.

Sandercock, G. R., Bromley, P. D., and Brodie, D. A. (2005) Effects of exercise on heart rate variability: Inferences from meta-analysis. Medicine and Science in Sports and Exercise, 37, 433–439.

Stepanski, E. and Wyatt, J. (2003) Use of sleep hygiene in the treatment of insomnia. Sleep Medicine Reviews 7, 215-25.

Stutz, J., Eiholzer, R. and Spengler, C. M. (2019) Effects of Evening Exercise on Sleep in Healthy Participants: A Systematic Review and Meta-Analysis. Sports Medicine 49, 269-287.

Tucker, S. J., Marcelline, R. H., Pipe, T. B. and Stevens, S. R. (2000) Nurses' Ratings of Their Health and Professional Work Environments. Official Journal of the American Association of Occupational Health Nurses 58, 6, 253-267.

Uchida, S., Shioda, K., Morita, Y., Kubota, C., Ganeko, M., and Takeda, N. (2012) Exercise effects on sleep physiology. Frontiers in Neurology 3, 1-5.

World Health Organization (2020) Physical Activity and Adults. [online] Available at: https://www.who.int/dietphysicalactivity/factsheet_adults/en/ Last Accessed 10 February 2020

Wipfli, B., Rethorst, C. and Landers, D. (2008) The Anxiolytic Effects of Exercise: A Meta-Analysis of Randomized Trials and Dose–Response Analysis. Journal of Sport & Exercise Psychology 30, 392-410.

Yang, P. Y., Ho, K. H., Chen, H. C., and Chien, M. Y. (2012) Exercise training improves sleep quality in middle-aged and older adults with sleep problems: A systematic review. Journal of Physiotherapy 58, 157–163.

Youngstedt, S. D., O'Connor, P. J., and Dishman, R. K. (1997) The effects of acute exercise on sleep: A quantitative synthesis. Sleep: Journal of Sleep Research & Sleep Medicine 20, 3, 203–214.