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Describing the physiological and psychological components that affect paramedic wellbeing

Abstract

Literature throughout the years have identified that wellbeing includes a variety of concepts; primarily having social, physical, and mental components. Research still needs to identify how the key aspects of these themes link together to create a holistic wellbeing approach, especially in frontline emergency healthcare like paramedics. Linking together physiological indicators and psychological mediators is currently being investigated through a feasibility study at Anglia Ruskin University. We describe these components as an individual's state in relation to their heart rate variability, cortisol levels (physiological), and individual, social, and organisational mediators (psychological). We present a narrative review of selected literature to introduce and describe these components to the paramedic profession. This review is not exhaustive or representative of all literature on the topic and thus our description should be interpreted as an introduction to concepts of paramedic wellbeing that has not previously been combined or discussed in such a manner.

Keywords

Wellbeing; heart-rate variability; cortisol levels; psychological; physiological

Background

The wellbeing of paramedics is a topic of debate worldwide. The stress filled work environment is both challenging and exhausting for front line emergency care staff. Physiological indicators paint a picture of an individual's physical response to stress, whilst psychological mediators show how these individuals deal with stress in their daily lives. Identifying holistic issues of health and wellbeing is key to support paramedics in the performance of their duties and achieving a fulfilled lifestyle specific to the individual. This review highlights the scientific underpinning we need to understand, and the components associated with paramedic wellbeing. The review laid the groundwork for a feasibility study into the state of paramedic staff wellbeing.

Introduction

There are philosophical and scientific approaches that led to the development of many modern wellbeing models. Diener's (1984) "*Tripartite model of subjective wellbeing*" was fundamental in the development of wellbeing, positing "*three distinct but often related components of wellbeing: frequent positive affect, infrequent negative affect, and cognitive evaluations such as life satisfaction*". This idea expands into broader terms of wellbeing according to Keyes and Robitscheck (2009). The three components are subjective wellbeing (hedonic), psychological wellbeing, and social wellbeing (eudemonic) (Keyes and Robitscheck, 2009; Steptoe, Deaton and Stone, 2015). Although the term wellbeing is not a new concept, in recent years it has become the focus for charities and the news: now most commonly associated with individuals 'mental health' (NICE, 2009). The recent increase of awareness for mental health has seen the term wellbeing used to describe someone's mental rather than physiological state. It is important to look at all factors (physiological indicators and psychological mediators) that contribute to a paramedic's wellbeing to have a full understanding of how stressors affect it.

Physiological indicators

We can gauge the predominant physiological indicators through the parasympathetic response in terms of Heart Rate Variability and cortisol levels. Heart Rate Variability (HRV) is a result of the parasympathetic nervous system's response to a stressor; a beat-to-beat variance caused by physiological changes required to maintain homeostatic balance (Pomeranz et al., 1985). These are changes caused by traits of the 'fight-or-flight' response – first described by Cannon (1915) as activation of the sympathetic nervous system. This was later identified as the first stage of the general adaptation syndrome which regulates stress (Gozhenko et al., 2009).

The beat-to-beat variance specifically looks at the RR interval – the time between two successive R-waves of the QRS signal on the electrocardiogram (Lanfranchi and Somers, 2011). Multiple studies have shown HRV to be a good bio-indicator of stress. Kim et al., (2018) conducted a meta-analysis concluding that a high HRV signifies a person's ability to have more resilience and flexibility to stressors. This is opposite to low HRV which denotes a person has impaired regulatory and homeostatic autonomic nervous system function (Kim et al., 2018). Sloan et al. (1994) conducted one of the first studies to measure HRV associated with stress. They examined the RR intervals and heart period variability of 33 healthy participants using a 24-hour electrocardiogram. Periodic diary entries were also recorded which consisted of physical position, perceived physical effects and time of day. Their results showed a high correlation between an individual's recorded stress and a decrease in the RR interval. They also found an increase in the High Frequency (HF)/Low Frequency (LF) ratio, which suggests an increase in sympathetic nervous system activity when exposed to a stressor. A more recent study supports this idea, resulting in those with a higher HRV being more adaptive and able to 'self-regulate' their response to stress, including coping strategies and seeking help (Geisler, Kubiak, Siewert and Weber, 2013). Recent studies

tend to look at short-term changes in HRV (5-30 minutes). They do not provide any results for HRV over long periods and thus, have overall inconclusive conclusions (Punita et al., 2016; Sin et al., 2016; Endukuru et al., 2016; Vargas-Luna et al., 2013; Michels et al., 2013; Taelman et al., 2011; Filaire et al., 2010; Chandola et al., 2008). Those with a sustained low HRV have a higher correlation with morbidity and mortality, in particular coronary artery disease (Kemp and Quintana, 2013; Lampert et al., 2008; Lennartsson et al., 2016).

Furthermore, there is often job and gender bias in studies concerning heart rate variability. Jobs associated with being highly skilled are the focus of most studies with the presumption that they face higher stress levels. For example, Hjortskov et al. (2004) studied 12 females who worked in computing. They concluded that there was an increase in the HF/LF ratio suggesting females have a sympathetic response to stress. In comparison, Kang et al. (2004) studied 169 males via a self-reported questionnaire. They concluded that there was no significant change in HF/LF ratio in males in regard to work-related stress. Furthermore, Antelmi et al. (2004) identified a significant increase in low HRV in females compared to males – however it is important to note this was generalised and not specific to any particular stress. This is one example of the disparity between HRV studies. Stress is an individual perception and therefore unable to be quantified in the above studies (Sloan et al., 1996). Differing roles within the workplace are subject to different levels of perceived stress. Furthermore, the above studies cannot wholly state their results are due to the variables they focused on i.e. computing was the sole reason woman had increased HF/LF ratio in Hjortskov et al., (2004) study.

The most frequent results showed an association in parasympathetic activity when a stressor was introduced, resulting in an increase of the HF/LF ratio (Clays et al., 2010; Chandola et al., 2010; Kim et al., 2018; Castaldo et al., 2015). This differs to results found

by Dimitriev et al. (2015) where there was a reduction in HRV when they inflicted mental stress. The study does state there is a high risk of vulnerability for future inflictions of mental stress. Further research has shown a correlation between changes in HRV and the effect on individuals wellbeing when a stressor is inflicted i.e. public speaking in a laboratory environment (Filaire et al., 2010).

Based on the research above, it is fair to assume paramedics or emergency personnel would have reduced HRV based on the mental stressors faced in the workplace environment. Wong et al., (2012) found an association with rotating shift work and reduced HRV, as well as higher job strain which was self-reported by the emergency workers. This can be supported by Neufeld et al., (2016) who found that emergency personnel had reduced HRV as a result of reduced and disrupted sleep on workdays. Despite these findings, recent research identifies an association between increased HRV and chronic stress, suggesting decreases in the HF/LF ratio are based on acute stressors (Birze et al., 2020; Balzarroti et al., 2017). This therefore would suggest emergency personnel are predisposed to increased HRV due to the chronic stress they face in the workplace (Donnelly et al., 2016; Langan-Fox et al., 2011). It is clear there is still substantial research required to identify the changes in HRV as a physiological response to stressors. HRV allows a pragmatic approach towards individual's physiological wellbeing.

Cortisol is a steroid hormone and functions to stimulate the breakdown of glycogen to glucose in anticipation of the 'fight-or-flight' response – as described above. Cortisol levels are regulated by the Hypothalamus-Pituitary-Adrenal axis (HPAA). Multiple studies have shown cortisol levels to be a bio-indicator of stress (Goldstein, 1995; McEwen et al., 2006; Alobid et al., 2011; Chandola et al., 2010). The changes caused by the HPAA are seen through natural fluctuations in cortisol levels, observed throughout the day – highest when first

awake. High cortisol levels are usually indicative of the individual being under physiologically stress such as awaking from sleep or when the 'fight-or-flight' mode is activated. Although studies found by Chida and Steptoe (2009) in a systematic review found that increased cortisol levels in the morning is reflective of stress levels, a new phenomenon called the cortisol awakening response (CAR) identifies the increase in levels is normal for individual (Fries, Dettenborn and Kirschbaum, 2009; Hong et al., 2009). Cortisol levels are commonly obtained via saliva, blood, urine or hair samples. Salivary and blood samples of cortisol levels are primarily associated with acute responses to stress whereas hair samples can indicate chronic responses (Russell, Koren, Rieder and Van Uum, 2012).

Cortisol levels linked to stress have inconsistent results: positive, negative and no associations have all been reported (Ockenfels et al., 1995; Yang et al., 2002; Evans and Steptoe, 2001). Hoeger Berment et al. (2010) found individuals with high levels of anxiety to also have increased levels of cortisol in their salivary samples, whereas Takahashi et al (2005) reported no association between cortisol levels and perceived pre/post stress. Similarly, Golden et al., (2013) and Short et al. (2016) showed salivary cortisol regulation does not correspond with cumulative cortisol measurement in saliva, urine or hair. Both Short et al., (2016) and Xie et al., (2011) found significant associations between salivary and hair samples and cortisol levels and no significant association between urine samples and cortisol levels. Amongst studies in which participants self-administered their samples, there was no consistency and therefore inconclusive results were found. However, it can be seen that there are significant associations between gender and cortisol levels. Ellen, Netterstrom and Hansen (2006) found that women who self-reported high levels of time pressure, effort and reward imbalance had a high association with increased cortisol levels. They also found that men who self-reported high levels of effort, reward imbalance, and over commitment had a high association with increased cortisol levels.

Further support from Sjors, Ljung and Jonsdottir (2014) found a significant association amongst women in relation to non-work stress and increased cortisol levels. Despite this, they found that there was no significant association between work-related stress and increased steroid levels. Furthermore, there was no significant association between work and non-work-related stress and increased cortisol levels in men. Results from both Hjortskov et al., (2004) and Campbell et al., (2012) suggest there is a consensus of inclusive data regarding cortisol levels and stress. Both studies found 25% of participants had a significant association of increased cortisol levels and self-reported stress. However, it is apparent that cortisol must be taken into consideration with the individual's factors i.e. age, gender, genetic factors (Campbell et al., 2012).

These findings would suggest that cortisol levels associated to stress are inconclusive. However, in the context of emergency personnel, increased cortisol levels are significantly associated to increased levels of stress. This could therefore give insight into how individuals are coping with stress – work and non-work related. LeBlanc et al., (2012) found paramedics demonstrated significantly increased levels of anxiety, with significantly increased levels of salivary cortisol when faced with a simulated scenario. Furthermore, Nakajima et al., (2012) found changes in cortisol levels were associated with continual work stressors and lack of sleep. They also found that clinicians with the primary responsibility for patients had increased levels of cortisol compared to those who didn't.

It can be seen that increases in cortisol levels can be positively associated with acute stress experienced by the individual. It is apparent that paramedics and emergency personnel face chronic levels of increased stress, however research is currently limited in assessing the cortisol changes associated with this. Cortisol levels are an accurate and appropriate way

to measure individual's acute physiological response to stressors and gives the opportunity to assess their general physiological wellbeing.

Psychological mediators

The predominant psychological responses to stressors are categorised through individual or systems/organisational mediators to stress. Responses to stressors are not simple cause-and-effect processes. Individuals respond to stressors in different ways based on their experience and development and mediation of coping strategies. Research has shown stress has both positive and negative psychological effects (Linley and Joseph, 2004; Lupien et al, 2007). A new concept, a 'Stress Mindset' can be used to reflect the responses seen by individuals when exposed to a stressor (Crum, Salovey, and Achor, 2013; Crum, Akinola, Martin and Fath, 2016). There are two mindsets: the stress-is-enhancing and the stress-is-debilitating (Crum, Salovey and Achor, 2013). Crum, Salovey and Achor (2013) highlighted a positive association between the stress-is-enhancing mindset and active coping mechanisms. Shimanoe et al. (2015) identified weaker psychological stress responses to be associated with less frequent use of emotional support seeking and problem solving. These mindsets form part of Sasaki and Yamasaki's (2002) conceptualisation of coping, which further includes emotional expression and cognitive reinterpretation. In contrary, Kilby and Sherman (2016) found there to be no association between the stress-is-enhancing mindset and perceived lower levels of stress. This is further supported by Horiuchi et al. (2018) who also found no association between the stress-is-enhancing mindset and a psychological stress response through coping.

'Stress-Mindsets' focus on general stress responses, disregarding the context and individuality that can affect the response, a major limitation of the theory (Crum, Salovey and Achor, 2013). To overcome this issue, the theory of 'primary appraisals' can be used to focus on

contextual factors. A primary appraisal is the evaluation of both the stressor, and the individual's perception on how to cope (Folkman, Lazarus, Gruen and DeLongis, 1986). Other research suggests that both challenge and threat appraisals are required to determine an individual's ability to cope with stressors (Lyons and Schneider, 2005). As individuals will adopt different coping mechanisms dependent on the severity of the stressor perceived, it is important to research a variety of appraisals to have focused responses (Folkman, 2010; Jamieson, Mendes and Nock, 2013). For example, Fienberg and Aiello (2010) identified a difference in response when individuals were presented with threatening versus' challenging stressors. These differences are known to benefit some whilst others suffer as a consequence (Updegraff and Taylor, 2000). Identifying individuals' perceptions between challenging and threatening appraisals has proved difficult (Kilby and Sherman, 2016). For example, Crum et al., (2015) found those with the stress-is-debilitating mindset faced negative effects from small everyday stressors – impacting their mental and physical health (McIntyre et al., 2008). This can be further supported by Almeida (2005) and Delongis et al., 1982 who found these small everyday stressors evoke worse somatic outcomes than appraisals deemed life-threatening. Furthermore, predisposing factors such as anxiety can be predetermined to the stress-is-debilitating mindset, enforcing negative connotations without sufficient evidence supporting it (Eysenck et al., 2007).

In relation to emergency personnel, it is quite well known that they face higher levels of anxiety, depression and post-traumatic stress disorder (Alharthy et al., 2017; Bentley et al., 2012; Phillips, 2019). Sangwoo (2016) found a correlation between a stress-is-debilitating mindset and increased levels of job fatigue and cynicism. With paramedics facing increased levels of chronic stress, adopting a stress-is-enhancing mindset may improve their physical health long term (van der Ploeg and Kleber, 2003). However, these stressors are primarily

work-related and thus deemed appropriate to be dealt with by the organisation (Alharthy et al., 2017; Adriaenssens et al., 2011).

Alongside psychological mediators, responses to stressors are shaped by social and organisational factors. For example, whether stress is understood as positive or negative is connected to an individual's ability to do something about the external stressor. Individuals can respond to stressors when attitudinal and dispositional variables are available to them within the workplace, such as resilience, optimism and hope (Luthans, Youssef and Avolio, 2007; Jain, Giga and Cooper, 2013). Alongside these, organisational commitment is a major factor that effects individual's psychological wellbeing. Research shows that organisational commitment can protect individuals from negative stressors and provide them with stability. Individuals with a higher sense of organisational commitment are more likely to stay positive at work and exhibit the stress-is-enhancing mindset (Siu, 2008; Eisenberger, Huntington, Hutchinson and Sowa, 1986). Despite organisational commitment, research shows that work-related stressors have a negative effect on individuals wellbeing, consequently leading reduced motivation, work satisfaction and worsening physical health – for example paramedics are at increased risk of cardiovascular disease due to the chronic stressors they face (Wright, 2007; Sackey and Sanda, 2009; Ongori and Agolla, 2008; Hegg-Deloye et al., 2015). These negative implications result in reduced employee commitment, on the basis of little-no organisational commitment. Therefore, it is the role of the organisation to target both individualistic and collectivistic perspectives within the workplace to improve job quality. Individualistic perspectives focus on the individual. with little regard to the group's needs (Triandis, 2018). In comparison collectivistic perspectives focus on dealing with the whole group to maximise everyone's benefits and outcomes (Triandis, 2018). Dependent on the environment of the organisation the perceived commitment will differ, thus affecting individual's wellbeing differently (Meyer, Stanley, Herscovitch and Topolnytsky, 2002; Andolsek and

Stebe, 2004). One theory adopted by organisations is the Psychosocial Safety Climate (PSC). PSC refers to policies, practices and procedures for the protection of work psychological health and safety (Dollard and Bakker, 2010; Idris and Dollard, 2011; Idris, Dollard, Coward and Dormann, 2012). Through the use of the job-demands-resources framework, companies can use PSC to identify work conditions and work engagement and adopt pathways to intervene where appropriate (Dollard and Bakker, 2010; Idris and Dollard, 2011; Idris, Dollard, Coward and Dormann, 2012). PSC is adopted by most organisations as it focuses on common workplace stressors to improve several individuals work experience, rather than singling out issues (Karesek, 1992). Rickard et al., (2012) found the use of PSC increased levels of job satisfaction and decreased levels of emotional exhaustion and job turnover. Although PSC can effectively impact employees occupational stress, individual's psychological distress and emotional exhaustion are less effected by pathways implemented by the organisation leaving it to the individual to respond positively – if they have the capacity to do so.

The nature of the role of the paramedic is known to predispose workers to increased levels of occupational stress. Worsened by the increasing management pressures to reach targets, it is well known that paramedics have poor levels of work satisfaction and work engagement (Mildenhall, 2013; NHS, 2017). Paramedics often report lack of support from managerial roles and increased pressures due to continuous changing in staffing levels (Clompus et al., 2016). Organisations encouraging debriefing, performance appraisals and face-to-face quality relationships with management are seen to build and augment individual resilience (Clompus et al., 2016; Halpern et al., 2009; Essex et al., 2008).

Research into organisational impact on individual's psychological wellbeing allows companies to make practical changes. There is a clear correlation between lack of organisational

support/facilities and lowered employee's psychological wellbeing. It shows a clear area in which we can change positively to improve paramedics psychological wellbeing.

Conclusion

Paramedics have physiological and psychological factors that influence their overall wellbeing. Research in HRV is becoming more evident showing the changes of the body's physiological response to stress. These changes can also be seen in differing levels of cortisol levels when individuals are introduced to acute or chronic stressors. The physiological changes seen in individuals are often a result of social and work stressors.

Psychological mediators are more specific to the individual and thus hard to quantify; however, they are important to understand an individual's response to stress. Each response differs dependent on an individual's background, experience and current mindset. Social and organisational mediators play a substantial role in peoples' psychological mediators, as work-related stress increases problems. Research has shown the importance of organisational input in reducing work-related stress and seen to have a positive impact on employee's wellbeing. Although it is clear paramedics face substantial levels of work-related stress, research focusing on the impact these having on psychological mediators are required to identify what coping mechanisms can be adopted to positively impact all areas. Further research is required to link these four factors and to find association in individual's physiological and psychological responses to stressors. This will allow for a better understanding of paramedic's wellbeing needs and appropriate practical interventions.

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