**“Genetics loads the gun, but the environment pulls the trigger”: Novel, emerging and non-traditional risk factors in CVD**

In a series of articles, Andy Richardson, BANCC Educational Advisor, examines several important environmental and individual risk factors for CVD. This week, following on from the meeting of Global Leaders at COP26 in Glasgow, it considers the impact of, and exposure to, environmental factors, including pollution and noise.

Cardiovascular Disease (CVD) has a well-established and associative relationship with a range of primary risk factors, including genetics, diabetes, hypertension, hypercholesterolaemia and smoking. However, it is perhaps somewhat surprising to discover that new risk factors, often referred to as novel, emerging or non-traditional risk factors, are overlooked. It is suggested that many of these new risk factors play a role in the pathogenesis of CVD, either externally (environmental) (Cosselman, Navas-Acien & Kaufman, 2013) or internally (psychosocial and behavioural) (Neylon et al, 2013). For example, in cellular biology, it is postulated that over 100 ‘biomarkers’ have been identified as possible risks, so it is clear this a scientifically complex area, that is evolving, and where there is still much to learn (Buchan, Thomas & Baker, 2012).

Non communicable diseases (NCDs) are a major global burden to human health (Munzel et al, 2021) and contribute to around 38 million deaths per year, 70% of which are associated with CVD. In addition to many well established genetic, biological, clinical, and behavioural risk factors for CVD, environmental determinants, like pollution and noise, are emerging as novel risk factors. This is important given their potential for population level risk reduction and is this that provides the focus of this short article.

Links between the environment and health have long been established. In November 2021, the United Nations Climate Change Conference met in Glasgow, known as COP26, demonstrated a perfect illustration of how interaction between humans and the planet are intrinsically connected, and that there appear to be a general political will and commitment to mitigate environmental catastrophe caused by climate change. Many environmental risks are beyond individual control, and in this sense are non-modifiable, but the global impact of these risks is very evident, as can be seen in severe climate change, leading to wildfires, desert storms and floods (Munzel *et al*, 2021). The World Health Organisation (WHO) have identified environmental health risks posed by air pollution, artificial light at night and noise as considerable threats to human health, with up to 80% of deaths relating to poor air quality that maybe linked to CVD (Kristen, *et al*, 2015). Long term exposure to air pollution increases all cause and CV mortality (Hyeanji et al, 2017). In addition to pollution, exposure to heavy metals, such as lead, and cadmium have been implicated in the development of CVD. Research has shown that the complex chemical, and physiological pathways are involved, that lead to hypertension and dyslipidaemia, all of which play a prominent role in disturbing vascular function (Munzel *et al* 2021).

Munzel et al (2021) explains that the complex interaction between environment and the individual, termed ‘exposome concept’, is a useful way to think about it. The exposome concept describes a cumulative, multiple exposure (external) environmental risk that interacts with an individual’s genetics (and lifestyle), to combine and cause changes in our circadian rhythm (‘clock’) genes. In simple terms, the phrase: “Genetics loads the gun, but the environment pulls the trigger” is a powerful metaphor to help conceptualise this (Bray, Paeratakul & Popkins, 2004). In other words, over the course of our lifespan, our biology is constantly exposed to, and interacts with environmental influences. To illustrate this, we can use an everyday example of an emerging CVD risk: environmental noise.

Noise

Environmental noise can be defined as unwanted or harmful sound, created by human activity (Murphy & King, 2014). Exemplars are myriad, but we can intuitively relate to, and remember examples of personal exposure to noise. Think for example of the levels of traffic noise experienced in large city centres, from road, rail, or air traffic. Noise is a major public health issue, and with cars the predominate form of transport in the United Kingdom (UK), the number of licensed vehicles registered in 2021 is now 39.2 million (Gov.uk, 2021). Using Munzel’s theory, traffic noise (the environment) is known to induce stress reactions in some individuals (genetics) and can affect them physically and psychologically. Hahad et al (2019) notes that large epidemiological studies have shown that noise from aircraft, roads and rail traffic are shown to increase CVD morbidity and mortality. Fuks (2017) and Munzel & Sorensen (2017) found increased hypertension through long term noise exposure. Kempten et al (2018) study found high quality evidence linking road noise to ischaemic heart disease (IHD). Further studies by Osborne *et al* (2020), investigated the neurobiological mechanisms found in stress responses to noise, and suggest that increased limbic-amygdala activity, leads to arterial inflammation, a precursor and known harbinger for CVD. Further evidence from Sorensen *et al* (2012) links road traffic noise to a higher risk of myocardial infarction (MI), and Saucy *et al* (2021), noted exposure to night-time aircraft noise may be associated with cardiovascular death. Although these studies do not establish cause and effect, there is evidence to support long term exposure to noise is harmful to the cardiovascular system. Whilst the exact mechanisms involved remain unclear, chronic exposure to noise is linked to elevated stress hormones, forming a ‘noise-stress concept’, all of which is known to lead to cellular oxidation, endothelial dysfunction, and hypertension (Hahad et al, 2019).

So, why is this an important issue for nursing and how should cardiac nurses respond to this? Many factors can be considered when undertaking a health consultation with people, occupation, housing, and their geographical location. If we take for example occupation, many industries such as construction, manufacturing, and agriculture, and occupations such as publicans, healthcare professions (such as dentists), musicians, and airport staff have all been linked to prolonged exposure to noise (European Agency for Safety and Health at Work, 2006). It is suggested that nurses should consider occupational factors, such as exposure to noise, when caring for people, and factor this into any CVD risk assessment. Living in urban and city dwelling areas may expose people to chronic noise, affecting mental health, increasing rates of anxiety and depression (Beutel et al, 2016), which should be assessed. Also, it is worth remembering that noise may impact on other aspects of health, such activities of living (ALs), such as fragmented sleep, which can affect well - being and mental health (Halperin, 2014).

In summary, environmental factors can play a key role in CVD risk. It is incumbent on governments to produce healthy public policies that include protective measures to reduce the harmful effects of noise on populations. As healthcare professionals there are many aspects of the environment that affect health, many are beyond our control. Nevertheless, it is recommended that practitioners consider the impact of environmental factors, like pollution and noise, on the general well-being of people in their care, as well as those at risk of, or with, CVD.

Thought I could add this image to the article



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