Firefighting demands performing heavy muscular work under adverse and potentially dangerous conditions. Although the physiological and psychological responses to simulated firefighting activities have been described, the heat strain has not been characterised using standardised indices of exercise–heat strain. The purpose of the study is to describe the physiological and perceptual strain associated with working in personal protective equipment and performing simulated firefighting activities in a hot environment using recently developed strain indices (Physiological Strain Index (PhSI); Perceptual Strain Index (PeSI)). Data from two previously published studies (Smith et al. 1995, 2001) – one a laboratory-based study and one a field-based study – were re-analysed incorporating the strain indices. The laboratory study involved walking on a treadmill for 15 min while wearing three different clothing and equipment configurations. The field study involved three trials of standardised firefighting tasks in a live-fire training structure (mean trial length = 5.76 min). Heart rate, rectal temperature, thermal sensations and ratings of perceived exertion were collected in each study. PhSI and PeSI values were calculated using the formulae developed by Moran et al. (1998b) and Tikuisis et al. (2002), respectively. PhSI and PeSI increased significantly over time in both studies. Even relatively brief bouts of exercise while wearing heavy impermeable clothing or simulated firefighting activity in the heat results in moderate to high levels of heat strain as assessed by PhSI and PeSI.

**Keywords:** physiological strain index; psychological strain index; firefighting; personal protective equipment

Heat stress can be referred to as the various physical and environmental components that combine to create the heat load (stress) under which an individual works. The physiological response and the resulting thermoregulatory processes to combat this heat stress are known as heat strain. Researchers have attempted to develop heat strain indices in order to quantify the physiological strain that workers experience when exposed to hot environments and/or when working in protective clothing. Such indices can also be useful in predicting an individual’s tolerance to different activities in the heat. Despite considerable effort over several decades, many of the proposed indices are of limited use because they have not been sufficiently validated or because the variables necessary to calculate the index are not able to be practically measured (Moran et al. 1998b). For example, Robinson et al. (1945) developed a formula to calculate physical heat strain that included summing four components: heart rate (HR); core temperature; skin temperature; sweat rate. This formula has been criticised because of the difficulty in measuring sweat rate, because equal weight is given to each of the variables and because it may not be equally valid across situations and populations (Moran et al. 1998b).

In order to overcome these limitations, Moran et al. (1998b) developed the physiological strain index (PhSI), which combines the relatively easily obtainable core temperature (as measured by rectal temperature ($T_{re}$)) and HR, normalises these variables and assigns them equal weight. The PhSI formula is as follows:

$$\text{PhSI} = 5(T_{re} - T_{ro}) \cdot (39.5 - T_{ro})^{-1} + 5(HR_t - HR_0) \cdot (180 - HR_0)^{-1}$$

(1)

where $T_{re}$ and $HR_t$ are assessments at some point in time and $T_{ro}$ and $HR_0$ reflect a baseline state. These two physiological components (core temperature, HR) are reflective of the thermoregulatory and...