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DEBNEY, Matthew, TILLER, Nicholas <<http://orcid.org/0000-0001-8429-658X>>, O'HAGAN, Ciara and PURVIS, Alison <<http://orcid.org/0000-0002-3581-4990>>

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Reliability of a tennis-specific treadmill protocol performed in temperate and hot conditions

Matthew J. Debney*, Nicholas B. Tiller, Ciara J. O'Hagan, Alison J. Purvis

Academy of Sport and Physical Activity, Sheffield Hallam University, UK

* Corresponding author: m.debney@shu.ac.uk @mattdebney

Laboratory protocols allow for the assessment of physiological function that cannot easily be observed in the field; however, there are currently no suitably reliable protocols for the assessment of physiological responses to tennis match-play. Accordingly, the aims of this study were to design a laboratory-based, tennis-specific treadmill protocol, and determine the between-day reliability of physiological responses in both temperate and hot conditions. The treadmill protocol was designed to simulate the published time-motion (Kovacs 2006, *British Journal of Sports Medicine*, 40, 381-386; Filipčič & Filipčič 2006, *AUC Kineanthropologica*, 42(1), 41-53) and match-play characteristics (Reid, Morgan & Whiteside 2016, *Journal of Sport Sciences*, 34:19, 1791-1798) of professional tennis players. The protocol comprised three sets of nine games, each consisting of six points, with 20 s rest-periods between points. The total match duration was 92.15 min, and treadmill speed ranged from 10 - 20 km·hr⁻¹. Following approval from the institutional research ethics committee, 17 healthy, male amateur tennis players volunteered to participate (age = 24 ± 6 years; mass = 76.6 ± 10.1 kg; stature = 179.5 ± 6.5 cm; $\dot{V}O_{2\max}$ = 50 ± 4 ml·kg⁻¹·min⁻¹). Participants completed the treadmill protocol twice in temperate (n=12; 20.2 ± 0.6 °C; 48.1 ± 7.4% relative humidity) and/or twice in hot (n=11; 35.9 ± 0.8 °C; 50.2 ± 4.9% relative humidity) conditions, each test performed on separate days. Measures included core temperature (T_c) via rectal thermistor, skin temperature (T_{sk}) via skin thermistors, capillary blood lactate concentration ([BLa]) via an enzymatic method, oxygen uptake ($\dot{V}O_2$) via an online system, heart rate (HR) via telemetry, ratings of perceived exertion (RPE) via the Borg scale, and perceptions of thermal sensation (TSS) and thermal comfort (TC). Physiological Strain Index (PSI) was derived from T_c and HR, and sweat rate (SR) was calculated from pre-to-post-trial nude body mass. Between-day reliability was determined using coefficient of variation (CV) and intraclass correlation coefficient (ICC). In temperate conditions, T_c , T_{sk} , HR, $\dot{V}O_2$, and TSS showed the strongest reliability (all CV <5%, ICC 0.7 – 0.971) when compared to SR, PSI, [BLa], RPE, and TC (CV 5 – 16%; ICC 0.770 – 0.964). In hot conditions, T_c , T_{sk} , HR, $\dot{V}O_2$, and TSS showed the strongest reliability (all CV <5%; ICC 0.862 - 0.984), when compared to SR, PSI, [BLa], RPE, and TC (CV 6 – 19%; ICC 0.829 – 0.935). The tennis-specific treadmill protocol allowed for the reliable assessment of core temperature, skin temperature, heart rate, O_2 uptake, and thermal sensation, both in temperate and hot conditions. These data indicate that the protocol is appropriate for assessments of physiology-based interventions.