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Hydrodynamic Flow Velocity Changes with Linear Increase in Flume Speed

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Research using recirculating swimming flumes (RSF) have made assumptions regarding hydrodynamic flow characteristics. Knowledge of hydrodynamic flow characteristics absent of a swimming body is required to enable analysis of aquatic based biomechanical data. **PURPOSE:** To determine hydrodynamic flow characteristics of a swim flume at set 'speeds' around the centroid of flow projection. **METHODS:** Utilizing a RSF (1.7m wide, 4.25m long, 1.2m deep), hydrodynamic velocity profiles were collected via 3D profiling velocimeter, sampling at 200Hz. Data were recorded 0.5m and 1.5m from the start point at arbitrary designated flume 'speeds' of 30-95 (+99) in 5 unit increments. Velocity data were collected for 1min per trial (location x speed), to determine mean flow velocity (MFV) for $10cm^2$, $20cm^2$, $30cm^2$ and $40cm^2$ cross-sectional areas (CSA). A multifactorial RMANOVA was conducted comparing CSA from the surface by distance from current channel (4x2). Separate RMANOVAs were conducted to assess differences in MFV across each CSA. **RESULTS:** There was a main effect for distance ($F_{1,14} = 203.52$, $P<.001$, $\eta^2_p = .93$). Post hoc yielded MFV at 0.5m to be significantly ($P<.001$, 95% CI, .07 - .1 m/s) greater than at 1.5m. RMANOVA revealed CSA at .5m had different effects on mean flow velocity (MFV) ($F_{3,42} = 114.77$, $P < .001$, $\eta^2_p = .89$). Post hoc yielded greater MFV for $10cm^2$ than $30cm^2$ ($P<.001$) and $40cm^2$ ($P<.001$), $20cm^2$ was greater than $30cm^2$ ($P<.001$), $20cm^2$ was greater than $30cm^2$ ($P<.001$) and $40cm^2$, and $30cm^2$ was greater than $40cm^2$ ($P<.001$). RMANOVA revealed CSA at 1.5m had different effects on MFV ($F_{3,42} = 118.15$, $P<.001$, $\eta^2_p = .89$). Post hoc yielded greater MFV for $10cm^2$ than $30cm^2$ ($P<.001$) and $40cm^2$ ($P<.001$), $20cm^2$ was greater than $30cm^2$ ($P<.001$) and $40cm^2$ ($P<.001$), and $30cm^2$ was greater than $40cm^2$ ($P<.001$). **DISCUSSION:** Significant differences between flow CSAs indicate that MFV is less for larger area at the same speed, indicative of variable and turbulent flow characteristics across the respective CSAs. MFV is further diminished by the distance from the flow channel as supported by the significant interaction, thus exposing an individual to variant flow velocities simultaneously. Limited stability of the flow velocity centroid could impact swim mechanics making the movement pattern no longer analogous to traditional pool or open water swimming.

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