We consider pressure-driven, steady-state Poiseuille flow in straight channels with various cross-sectional shapes: elliptic, rectangular, triangular, and harmonic-perturbed circles. A given shape is characterized by its perimeter $P$ and area $A$ which are combined into the dimensionless compactness number $C = P^{-2}/A$, while the hydraulic resistance is characterized by the well-known dimensionless geometrical correction factor $a$. We find that $a$ depends linearly on $C$, which points out $C$ as a single dimensionless measure characterizing flow properties as well as the strength and effectiveness of surface-related phenomena central to lab-on-a-chip applications. This measure also provides a simple way to evaluate the hydraulic resistance for the various shapes.