

## Supporting information

Table S1 Mann–Whitney test  $p$ -values and summary statistics for three kinds of centralities

centrality	$p$ -value	mean( $P_{\text{ordinary}}$ )	mean( $P_{\text{top}}$ )
degree	$3.248 \times 10^{-19}$	4.368	8.412
betweenness	$5.495 \times 10^{-18}$	48.96	100.95
k-core	$3.042 \times 10^{-14}$	2.044	2.712

Table S2 Mann–Whitney test  $p$ -value for different hypothesis and centralities

null hypothesis	$p$ -value		
	degree	betweenness	k-core
centrality increase ( $P_{\text{top}} \leq$ centrality increase ( $P_{\text{ordinary}}$ )	1	0.9836	1
centrality increase ( $P_{\text{top}} \geq$ centrality increase ( $P_{\text{ordinary}}$ )	$1.546 \times 10^{-61}$	$1.648 \times 10^{-2}$	$4.551 \times 10^{-65}$