The outer membrane is an essential load-bearing element in Gram-negative bacteria

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Gram-negative bacteria have a complex cell envelope consisting of a plasma membrane, a peptidoglycan cell wall, and an outer membrane. The envelope is a selective chemical barrier that defines cell shape and allows the cell to sustain large mechanical loads such as turgor pressure. It is widely believed that the covalently cross-linked cell wall grants the envelope its mechanical properties. We have recently demonstrated that the stiffness and strength of *Escherichia coli* cells are largely due to the outer membrane. Compromising the outer membrane, chemically or genetically, greatly increased deformation of the cell envelope in response to stretching, bending, and indentation forces, and induced elevated levels of cell lysis upon mechanical perturbation and L-form proliferation. Both lipopolysaccharides and proteins contributed to outer membrane stiffness. These findings overturn the prevailing dogma that the cell wall is the dominant mechanical element within the Gram-negative bacterial cell, instead demonstrating that the outer membrane is at least as stiff as the cell wall and that mechanical loads are often balanced between these structures.

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