Safety on low-volume rural roads is drawing attention due to the high fatality and severe injury rates in comparison with high-volume roads and the increasing awareness of sustainable rural development among policy makers. This study analyzes the risk factors associated with crash severity on low-volume rural roads, including crash characteristics, driver attributes and behavior, vehicle type, road features, environmental conditions, distance from the nearest hospital, and zone rurality degree. The data consist of a set of crashes occurred on low-volume rural roads in Denmark between 2007 and 2011. The crashes were identified by map-matching the crash location to the geographic information system representing the national transport network and extracting the relevant crashes based on annual average traffic volumes. Injury severity was modeled by estimating a generalized ordered logit model due to its advantage in accommodating the ordered-response nature of severity while relaxing the proportional odds assumption. Model estimates and pseudoelectricities show that aggravated crash injury severity is significantly associated with (1) alcohol and failure to wear seatbelts, (2) involvement of vulnerable road users (i.e., pedestrians, cyclists and motorcyclists), (3) involvement of heavy vehicles, (4) speed limits of 80–90 km/h, (5) longer distance to the nearest hospital, and (6) peripheral rural regions.