Beall is Distinguished University Professor and S. Idell Pyle Professor of Anthropology at Case Western Reserve University where she began teaching and research in 1976. She received a Ph.D. in 1976 and an M.A. in 1972 from The Pennsylvania State University where she trained with Paul Baker.

Beall is currently working to integrate genomics and human biology to discover how indigenous people living at high altitude evolve and adapt to the stress of very low oxygen availability. This contributes to the larger question of how evolution and adaptation operate in modern human populations.

Beall’s research focuses on explaining why Andean, Tibetan and East African highlanders differ in their patterns of biological adaptation to the unavoidable, severe stress of high-altitude hypoxia. This entails fieldwork in mountainous regions of Bolivia, Ethiopia, Nepal, Mongolia, Peru, and the Tibet Autonomous Region of China where millions of people live at altitudes of 10,000’ or more.

Her research began in the era when measurements of size and morphology, such as the lower birth weight of highland babies and the very large chests of Andean highlanders, were used to infer adaptation. Considering that most work on highlanders had been conducted in the Andes, during the late 1970s and early 1980s she decided to investigate whether highlanders everywhere adapt the same way. The finding that they adapt differently transformed the study of high-altitude human biology. The questions of how and why they differ have dominated Beall’s research.

She pioneered research on oxygen saturation of hemoglobin and hemoglobin concentration among highlanders. Hemoglobin is the blood molecule that carries and delivers oxygen. Oxygen saturation is measured by the percent of oxygen binding sites in hemoglobin that are occupied by oxygen. The percentage is inevitably lower at high altitude because of the ‘thin air’.

Lowlanders who visit high altitudes respond with a lower percent of oxygen saturation but an increased hemoglobin concentration. Andean highlanders resemble lowlanders, but Tibetans have extremely low percent of oxygen saturation yet maintain hemoglobin concentration at or near sea-level values. As a result their blood contains much less oxygen. Yet Beall found that Tibetans consume the same amount of oxygen as lowlanders and Andean highlanders.

The search for explanations led to quantitative genetics analyses revealing that genetic variation accounts for a substantial portion of individual variation in hemoglobin concentration in both populations. As for oxygen saturation of hemoglobin, Beall and her collaborators detected a dominant major gene for higher oxygen saturation, but only among Tibetans. Furthermore, Tibetan women estimated to have the dominant gene had more than twice the number of living children as other women. This was strong evidence of natural selection favoring the inferred allele associated with high saturation. Yet, Tibetans with the estimated genotypes for high saturation still have low saturations compared to others at altitude (those with the estimated genotype for low saturation have exceptionally low saturations).

Beall and her collaborators have spent years investigating how Tibetans manage with the low percent of oxygen saturation in their blood and have discovered an important role for nitric oxide, a gas that is synthesized throughout the body including in the lining of blood vessels where it functions to dilate blood vessels and increase blood flow and oxygen delivery. Finding that Tibetans have uniquely high levels of nitric oxide in their lungs and circulation transformed the study of high-altitude human biology again. She is currently examining the blood vessels of Sherpa highlanders using video microscopy to
evaluate capillary density and morphology to determine their size and shape and the speed of blood flow through them.

Beall’s research has recently moved into the genomics era. She and her collaborators discovered that a genetic locus known to be involved in the response to low oxygen levels (EPAS1, also known as HIF2A) accounts for the relatively low levels of hemoglobin concentration among Tibetan highlanders. Tibetans have high frequencies of EPAS1 variants that associate with the low hemoglobin concentration. The benefit of this response – essentially a dampening of the usual response – is that it avoids the risks, such as strokes due to thicker blood, associated with very high hemoglobin levels. This is further evidence of evolution by natural selection among Tibetans.