Tuberculosis, caused by *Mycobacterium tuberculosis*, remains a major global health threat, responsible for approximately 1.3 million deaths annually. Understanding the host immune response to mycobacterial infection is essential for developing new strategies to combat tuberculosis. In our study, we used *Mycobacterium marinum* infection in zebrafish (*Danio rerio*) - a well-established model mimicking human tuberculosis - to investigate the role of the inflammasome adaptor *pycard*. Using CRISPR/Cas9 mutagenesis, we generated two zebrafish *pycard* knock-out lines. While *pycard* deficiency had no apparent effect on infection resistance during the larval stage, adult *pycard*-deficient zebrafish displayed increased susceptibility, characterized by reduced survival and elevated bacterial burden. Histological examination revealed larger granulomas in mutants compared to wild type controls, suggesting altered immune regulation. Transcriptomic analysis of the kidney, a key haematopoietic organ in zebrafish, suggested that *pycard* influences neutrophil-mediated defence, haematopoiesis, and myelopoiesis during infection. Further profiling of fluorescently labelled kidney neutrophils revealed differential expression of genes involved in neutrophil degranulation, haematopoiesis, and PI3K signalling in *pycard* mutants. Our findings indicate, that *pycard* regulates neutrophil function and it is essential for immunity against mycobacterial infection in adult zebrafish. Our research enhances our understanding of inflammasome-related host defence mechanisms and provides insights potentially relevant to pathogenesis of mycobacterial infection.