Chagas disease caused by the intracellular protozoa *Trypanosoma cruzi* is one of the major human health problems in Latin America. The disease evolves through an acute to a chronic phase, where in subjects may be clinically asymptomatic or show progressive heart disease leading to an end-stage dilated cardiomyopathy in 20–30% of the infected individuals. It is estimated that approximately 4 million chagasic individuals have developed heart disease, making Chagas disease the most frequent cause of infectious cardiomyopathy in the world.\(^1,2\)

Immune control of *T. cruzi* is complex, requiring the generation of a substantial antibody response and the activation of both CD4 and CD8 T cell responses. Even in cases in which such responses are stimulated sufficiently to control the acute infection, *T. cruzi* is not completely cleared but instead, persists in infected hosts for decades.\(^3\)

The peripheral T cell repertoire is in a constant state of flux as these cells see numerous environmental signals that are continuously varying.\(^4\) After a first encounter with cognate Ag, naive T cells proliferate and acquire effector function. As infection is controlled, the majority of T cells mediating the primary response die and a small population remains to form the memory population.\(^5,6\) A different situation occurs if the pathogen is not eliminated, where immune T cells are recurrently stimulated by these pathogens and T cell clonal exhaustion might occur.\(^7\) Moreover, the environment of a persistent infection may lead to a situation of general immune activation that also drives T cells not specific for the persisting pathogen to a differentiated state with impaired proliferation and interleukin (IL)-2 production in response to antigen or agonist T cell receptor (TCR)-specific antibodies, and variable reduced secretion of interferon-gamma (IFN-γ) that will ultimately result in exhaustion.\(^8,9\)

We have shown that humans with long-term (> 20 years) infection with *T. cruzi* have relatively modest CD4+ and CD8+ T cell responses to *T. cruzi* proteins/peptides and that the whole CD4+ and CD8+ T cell population in these subjects shows signs of exhaustion and senescence, consistent with the persistence of infection in these individuals.\(^10,11\) In the face of persistence stimulating antigen, we hypothesize that the *T. cruzi*-specific...
We also measured the expression of the IL-7 receptor, involved in the development and maintenance of T cells. Decreased expression of IL-7R on naive (Figure 3A and C) and on antigen-experienced total CD8+ T cells with various degrees of differentiation (Figure 3B and D) was observed in *T. cruzi*-infected children compared with uninfected subjects. Conversely, the analyses of the activation molecules HLA-DR and caspase-3 as well as the marker of replicative senescence, CD57, on naive, memory, and effector total CD8+ T cells did not vary in *T. cruzi*-infected children (data not shown).

These findings show that in chronically *T. cruzi*-infected adult subjects, the naive and antigen-experienced T cell compartments in children in early stages of the disease already reflect the impact of antigen persistence, with naive T cells being likely constantly stimulated and driven into the effector response that may in turn exhaust T cell responses as observed in long-term adult *T. cruzi*-infected individuals. However, these *T. cruzi*-infected children show fewer signs of immune senescence compared with adult subjects who display high levels of CD4+ and CD8+ T cells expressing CD57 and high levels of apoptosis in the T cell compartment. In pediatric human immunodeficiency virus (HIV) infection a decrease in naive CD8+ T cells has also been shown supporting that persistent infections may affect thymic output of naive T cells.

Accumulated evidences have shown that the combined action of benznidazole and the host immune system has a role in the efficacy of anti-*T. cruzi* chemotherapy. The less senescent immune status observed in children than in adult *T. cruzi*-infected subjects might support, somehow, previous observations showing that chemotherapy against *T. cruzi* is more effective in children than in adult subjects. Therefore, early treatment could result in higher treatment efficacy.

Our data are in agreement with those from Laucella and others showing high levels of soluble P-selectin and soluble vascular cell adhesion molecule-1 (VCAM-1), which reflects endothelial activation distinctive of an ongoing inflammatory process in *T. cruzi*-infected children. Nevertheless, other authors have reported an overall low immune activation in early indeterminate Chagas disease with a mixed pro- and anti-inflammatory cytokine profile.

Competent and effective T cell responses are crucial to limit parasite replication and the direct damage that this can do. The results shown herein suggest that the duration of the infection may be implicated in the development of immune senescence in chronic Chagas disease. Additional longitudinal studies will be necessary to ascertain this hypothesis.

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Figure 3. Interleukin (IL)-7R expression in naive and antigen-experienced CD8+ T cells in T. cruzi-infected children. Each point represents the expression of IL-7R on the total (A) CD45RA+CD28+ and (B) CD45RA CD28+CD8+ T cell populations. Median values are shown by horizontal lines. Comparisons between groups were performed by Mann-Whitney U test. Representative histogram for the expression of (C) CD8+CD45RA+CD28+IL7R+ and (D) CD8+CD45RA+CD28+IL7R− in one T. cruzi-infected child and one uninfected control. The numbers show the percentage of naive (C) and memory CD8+ T cells that express the IL-7R (D).

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