

ISPAD-Breakthrough T1D Research Fellowship Progress Report

Project title: Bone health in youth with type 1 diabetes

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Project duration: 4/1/2025 – 6/30/2027

I am a clinical research investigator dedicated to improving the quality of life and long-term health outcomes for children and adolescents with type 1 diabetes (T1D), with a specific focus on bone health. My current project explores the impact of T1D on bone health in youth, specifically regarding bone marrow adipose tissue (BMAT).

Since receiving ISPAD-Breakthrough T1D funding, I have secured the additional necessary funding, obtained regulatory approval, and fully established the study framework. While designing a cohesive study day that accommodates both pediatric and adult patients for simultaneous data acquisition presented initial logistical challenges, these were successfully resolved by coordinating the resources of the MR Research Center (MRRC) and the Translational Research Center (TRC) at the University of Pittsburgh.

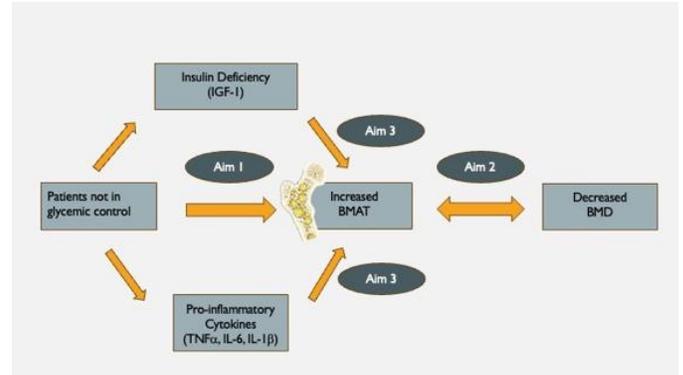
Data collection for the study includes imaging (MRI-BMAT and DXA-BMD), laboratory results, anthropometrics, and diabetes management and glycemic control metrics. Serum and plasma have been banked for all participants to assess cytokines, bone turnover markers, and other indicators of bone health and diabetes management upon study completion. Recruitment is currently underway; to date, we have completed study visits for four controls and two individuals with T1D. Additionally, four individuals with T1D are currently in the enrollment and scheduling process, with several potential participants awaiting further phone screening.

In parallel with this research, I have authored a review publication, *Disparities in Pediatric Bone Health*, and have been named a Pediatric Endocrine Society (PES) Rising Star. I was also awarded an NIH T32 training grant and selected as a Scholar in the University of Pittsburgh-Burroughs Wellcome Fund Physician Scientist Incubator Program. These training programs have provided valuable career development coaching, statistical training, and opportunities to present on bone health in T1D and health disparities. I remain actively involved in several concurrent clinical studies related to bone health.

Brief summary: Bone Health in Youth with Type 1 Diabetes research project

Individuals with T1D are at an increased risk of fractures, but bone health in T1D is historically understudied, and the mechanisms behind this increased risk remain unclear. It is likely that a dysfunctional bone microenvironment contributes to the fracture risk. In adults, high levels of BMAT are linked to low bone mineral density (BMD) and increased fracture risk, but this relationship has not been established in youth with T1D. I aim to begin characterizing the difference in bone parameters between healthy post-pubertal youth and individuals with T1D by examining BMAT content, BMD, and markers of bone turnover. I hypothesize that post-pubertal adolescents with T1D and an elevated hemoglobin A1c (HbA1c >9%) exhibit higher BMAT and lower BMD compared to those with HbA1c in target range and healthy controls, and that these differences correlate with insulin deficiency and inflammation.

To address these questions, I am conducting a cross-sectional pilot study with three cohorts: 1) healthy, non-diabetic adolescents; 2) adolescents with T1D and HbA1c within target (HbA1c <7%); and 3) adolescents with T1D and an elevated HbA1c (HbA1c >9%). Using proton MR-spectroscopy (1H-MRS), she will quantify BMAT (lipid-to-water ratio) in the lumbar spine and femur. Dual-energy X-ray absorptiometry (DXA) will assess BMD across groups. Serum biomarkers of bone metabolism, insulin deficiency (as measured by IGF-1), and inflammatory markers will also be measured. My primary aims are: (1) to characterize and compare BMAT, BMD, and bone metabolism markers across the three groups; (2) to investigate correlations between BMAT, BMD, and bone metabolism markers; and (3) to explore the relationships between BMAT, insulin deficiency, and proinflammatory cytokines. This will be among the first studies exploring the possible association of BMAT with insulin deficiency and/or inflammation in adolescents with T1D, offering novel insights into metabolic determinants of impaired bone health.



Current status:

- Obtained IRB approval (spring 2025)
- Obtained fiscal approval (spring 2025)
- Worked with the University of Pittsburgh Translational Research Center (TRC), MR Research Center (MRRC), and hospital lab staff at the University of Pittsburgh Medical Center (UMPC), to establish the protocol (spring and summer 2025). The protocol includes MRI hip/femur and lumbar spine, DXA scans, blood draw, physical activity questionnaires, history and physical exam, and chart review.
- Created logs and databases for storage and organization of study materials and results (spring and summer 2025).
- Utilized Pitt + Me (online study recruitment tool at the University of Pittsburgh), chart review, and diabetes clinics to recruit potential participants. 123 providers/patients with T1D approached to date. 19 individuals with T1D met inclusion/exclusion criteria and agreed to be contacted (summer/fall 2025 to present).
- 2 Males with T1D with HgbA1c <7% (for at least 6 months) completed the study protocol to date. 3 additional males with T1D with HgbA1c <7% screened and awaiting enrollment (working around students school schedules). 1 Male with T1D and HgbA1c >9% screened and working on scheduling. 1 declined to participate and currently in communication with the remaining potential participants.
- 4 Control participants completed to date (2 male, 2 female) with ~10 additional screened, interested, and available for participation.

Future Directions: Recruitment is projected to conclude between Spring and Summer 2026, immediately followed by comprehensive data analysis and assays on banked samples for cytokines, bone turnover markers, and other indicators of bone health and diabetes management. We plan to submit an abstract to ISPAD 2026 and are targeting manuscript publication for Fall 2026. This cross-sectional study represents a critical first step in assessing the impact of T1D on bone health in youth, specifically regarding bone marrow adipose tissue (BMAT), and may offer valuable insights into fracture prevention strategies. To our knowledge, this will be the first study to investigate the association between BMAT, insulin deficiency, and inflammation in adolescents with T1D. Furthermore, the data collected will be essential for generating accurate power calculations to support future large-scale cohort studies. Ultimately, these findings will help guide future interventions aimed at identifying therapeutic targets to reduce fracture risk in the T1D population.