In young growing humans and rodents, diabetes mellitus can lead to growth retardation and low bone density, but how diabetes mellitus alters bone structure remains unclear. In the present study, we used micro-computed tomography to visualize the 3-dimensional structure of cortical envelope and evaluate volumetric bone mineral density of femora (long bone) obtained from non-obese Goto-Kakizaki rats, which exhibited type 2 diabetes mellitus with high fasting plasma glucose level (hyperglycemia) and insulin resistance. The results showed that diabetic rats had lower volumetric bone mineral density in the femora (especially in the trabecular part) and L5–6 lumbar vertebrae as compared to the wild-type rats. They also had lower femoral cortical bone area and moment of inertia, the latter of which was an indirect indicator of bone strength. In addition, the shorter femoral and tibial lengths in diabetic rats suggested that endochondral bone growth was impaired. A histomorphometric analysis further showed that the total height and hypertrophic zone height of the tibial growth plates in diabetic rats were lower than those in the wild-type rats. On the other hand, the height of epiphyseal resting zone was markedly greater in diabetic rats as compared to the wild-type rats. It could be concluded that type 2 diabetes mellitus was associated with aberrant growth plate histology and defective cortical structure. These findings could explain, in part, how diabetes mellitus led to impairment of bone structure.

Acknowledgement: We thank Dr. Dutmanee Seriwatanachai for technical assistance, National Laboratory Animal Center, NSTDA (to NK), and Faculty of Science, Mahidol University (to NC).