Osteoporosis – characterized by low bone mass and increased fracture risk – represents a major public health problem worldwide. Postnatal physiological changes due to altered hormonal and nutritive care as well as less mechanical stimulation within the first six months lead to a decrease in physiological bone density. Pathological osteopenia of the premature/neonate has to be differentiated. To determine osteopenia, the serum values for calcium, phosphate, and alkaline phosphatase are used in the clinical routine. But these parameters do not correlate with bone mineral density or mechanical elasticity and stability of the bone, which can be evaluated using quantitative ultrasound (QUS). An essential advantage of QUS is, in addition to low costs, the possibility to perform measurements at the bed or incubator. Disadvantages are reduced standardization and lack of inadequate regional reference value studies. The present prospective monocentric study in Caucasian newborns aimed to determine speed of sound (SOS) reference values at the tibia and to evaluate different measurement locations. The practical applicability of the method in premature neonates was assessed.

Two hundred nineteen mature newborns (107 female, 112 male) and fourteen premature infants (6 f, 8 m; gestational age 28–41 weeks) were included in the study. For the reference data sampling, the following exclusion criteria were used: hypo- or hypertrophy (birth weight < 10th or > 90th percentile) and/or maternal gestational diabetes. Reference values were sampled in 178 eutrophic infants. The investigation took place within the first week of life. Measurements were taken with Sunlight Omnisense 8000 P sonometer using the cortex small probe (CS). SOS was evaluated in longitudinal transmission in the cortical bone. Measurements were performed on the tibia, humerus, and radius in the middle of the shaft.

Trial measurements on the radius and humerus did not lead to reproducible results. So, the study was only performed on the left tibia. SOS reference values at the tibia were 3028 m/s for gestational age < 40 weeks and 3057 m/s for ≥ 40 weeks. There was a significant correlation between SOS and gestational age. SOS was significantly higher in male (3058.3 m/s) than in female (3022.9 m/s) infants (p < 0.012). If birth weight was below 3.800 g, there was a correlation between SOS and weight (p < 0.05). Preterm infants showed lower SOS than term babies (p < 0.05). There was no significant influence on SOS for maternal factors (gestational diabetes, nicotine abuse, obesity, medication, age) or pediatric factors (birth mode, size, singleton/twin). Gestational age and gender were identified as independent prognostic factors for SOS on the tibia.

The standardized QUS assay using the small CS probe was characterized by high in vitro and in vivo precision. In the newborn, only the tibia is suitable as a measurement site for SOS evaluation; evaluation is also possible in extremely preterm neonates (28 weeks of gestation). In the regional Caucasian reference study group, QUS data was collected successfully and can be used now for subsequent studies in premature babies and for the assessment of osteopenia, taking gender, weight, and age into account.