a) Objectives of the research project

Diaphyses of long bones behave like beams when affected by mechanical loading (e.g. muscle activity, increase in body size). Therefore, given their cross-sectional properties, levels of applied loads can be calculated. Changes in the internal architecture of such diaphyses are preserved after death; thus, scientists can reconstruct the specific activity patterns of populations from the past.

In general, variations in femoral cross sections can provide information about activities such as walking, running and jumping. Many bioarchaeologists and archaeologists claim that habitual mobility patterns in Europe have changed from the Palaeolithic through the Neolithic to our own times, involving a significant decrease in mobility. This is probably associated with the transition from a hunting and gathering culture to an agriculturalist, more settled lifestyle. However, some studies showed that this process is more complex and that not all pre-agricultural and agricultural groups are characterised by a less robust femoral structure than hunter-gatherers.

Accordingly, the main purpose of this study is to conduct comprehensive analyses of changing human mobility from the Neolithic and mediaeval ages to modern times in Central Europe (Poland). We also wish to show what types and levels of mechanical loading could cause variations in femoral cross sections among archaic and modern human groups from different geographical areas.

b) Description of the research project

Femoral cross sections will be used to analyse human mobility. The analysed material will consist of computed tomography (CT) images of femurs of: **[1]** Palaeolithic hunter-gatherers (Neanderthals from Croatia, France, and Belgium, as well as anatomically modern humans from the Czech Republic and France), **[2]** modern hunter-gatherers (Australian aborigines), **[3]** a Neolithic pre-agricultural population (Poland), **[4]** a mediaeval agricultural population (Poland), and **[5]** a modern population (Poland).

From each CT image, five cross sections (at about 20%, 35%, 50%, 65%, and 80%) of the femur length from the distal end of bone will be prepared. Then, diaphyseal cross-sectional properties of the femur will be calculated and standardised to body mass. Finally, Geometric Morphometrics (GM) of the femoral cross sections will be performed. GM uses Cartesian coordinates of anatomical points on a surface and curves called semilandmarks to statistically analyse variations in shape between and within objects. From each cross section, 25 semilandmarks around the external and 15 semilandmarks around the internal cortical bone will be evenly distributed. Based on cross-sectional properties and shape, human mobility will be reconstructed.

c) Present reasons for choosing the research topic

The existing method of analysing human mobility has some limitations. Cross-sectional properties can provide information about levels of mechanical loading but cannot readily visualise differences in cross-sectional shape between analysed bones. For this purpose, GM is more accurate.

The visualisation of differences in a femoral cross section would be helpful in interpreting which muscles are more or less involved in given movements and why. Combination of the two methods (cross-sectional properties and GM) makes it possible to show differences in levels and types of activity involving the lower limb in human groups. Moreover, the use of material from different geographic and time range groups enables comprehensive interpretations of the femur responses to various forms of mechanical loading. Therefore, the proposed project will enable us to expand and correct existing knowledge about variation in human mobility from the Palaeolithic up to our times (with particular emphasis on changes in central Europe).