

# ECHOGRAPHIC DENSITOMETRY OF PROXIMAL FEMUR: CLINICAL EVALUATION OF A NOVEL ULTRASOUND APPROACH

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## Abstract

Hip fracture has been recognized as the worst consequence of osteoporosis, as it represents one of the most important causes of disability and mortality in elderly people. An accurate knowledge of the osteoporotic fracture risk in asymptomatic individuals through population mass screenings may be the only way to reduce the occurrence of hip fractures. Aim of this study was to perform a preliminary clinical validation of a new ultrasound (US)-based method for bone densitometry directly applicable on femoral neck. A total of 170 female patients were enrolled for this study (56-80 years of age) and all of them underwent two different diagnostic investigations: a conventional DXA (dual-energy X-ray absorptiometry) of the femoral neck and an US scan of the same anatomical region, acquiring both echographic images and unfiltered radiofrequency signals. US data were analyzed by a new algorithm that calculated the same diagnostic parameters obtained from DXA examination (BMD, T-score, Z-score). Accuracy of each parameter calculated by this algorithm was then evaluated through a direct comparison with DXA results as a function of both patient age and BMI. For 84.7% of the patients US diagnosis (osteoporotic, osteopenic, healthy) coincided with the corresponding DXA one. Pearson's coefficient values ( $r$ ) for each single parameter measured with the two methods were within the interval 0.66-0.81 ( $p < 0.001$ ) and this accuracy level was not appreciably influenced by patient age nor by BMI. The illustrated method has the potential to be used for routine population screening programs for early osteoporosis diagnosis and hip fracture prevention.

## Objective

To evaluate the diagnostic accuracy of a **novel ultrasound (US) approach to femoral densitometry** in a clinical context.



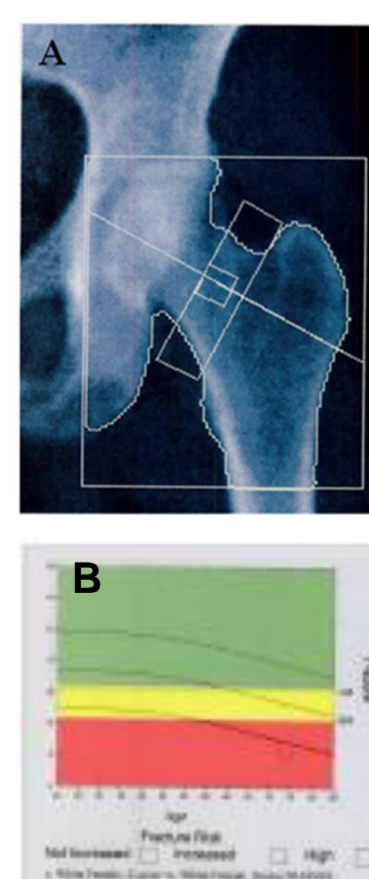
## Methods

A cohort of 170 female patients was recruited according to the following criteria:

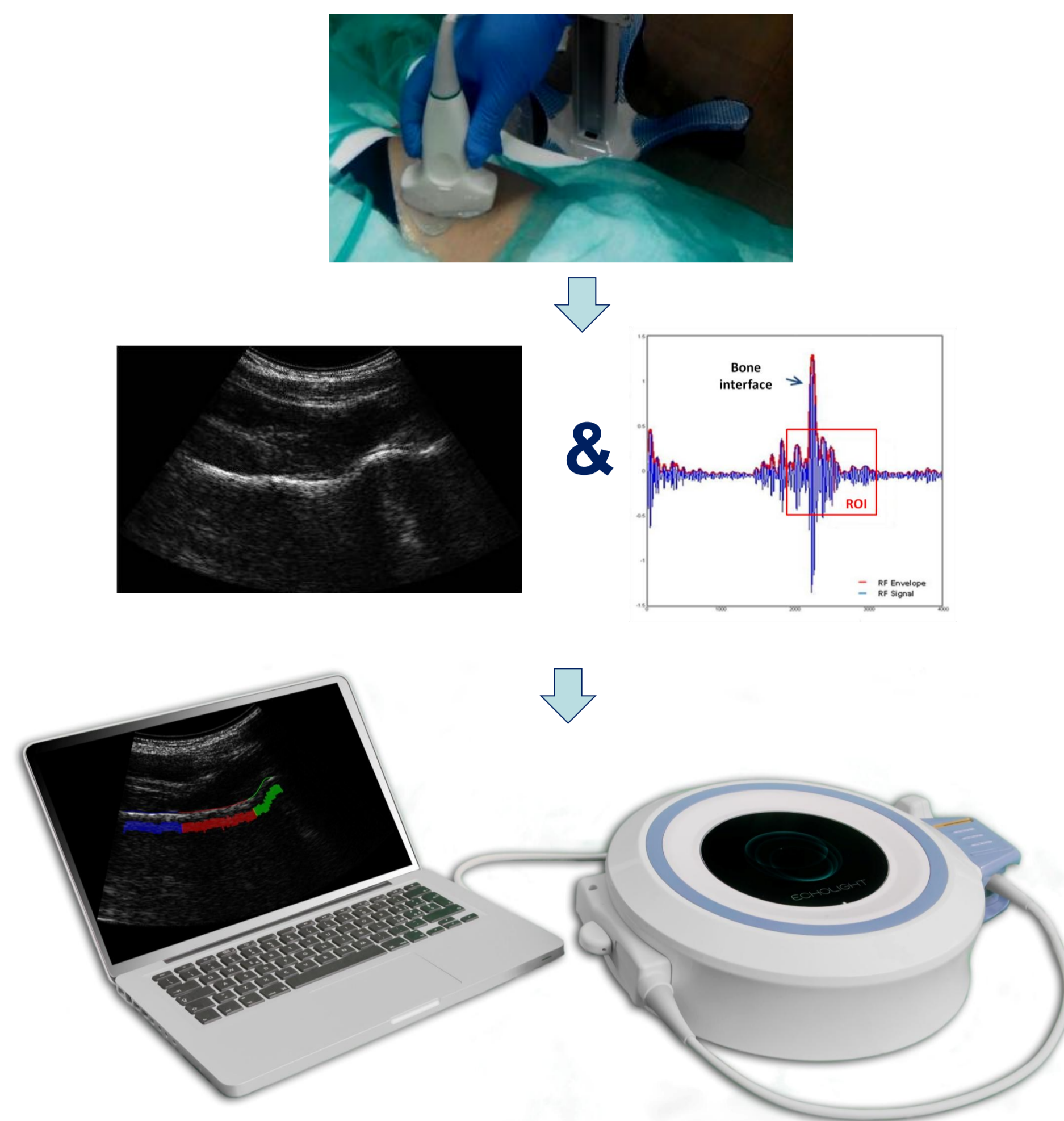
- ✓ 56-80 years of age;
- ✓ no severe deambulation impairments;
- ✓ medical prescription for a femoral DXA.

Each patient underwent two different diagnostic examinations:

### 1. Conventional femoral examination: DXA



### 2. US scan of femur: EchoS



#### US scan of femur

acquiring both US images and "raw" RF signals

#### Patient Classification

in homogeneous groups with similar age and BMI

#### Algorithm Application

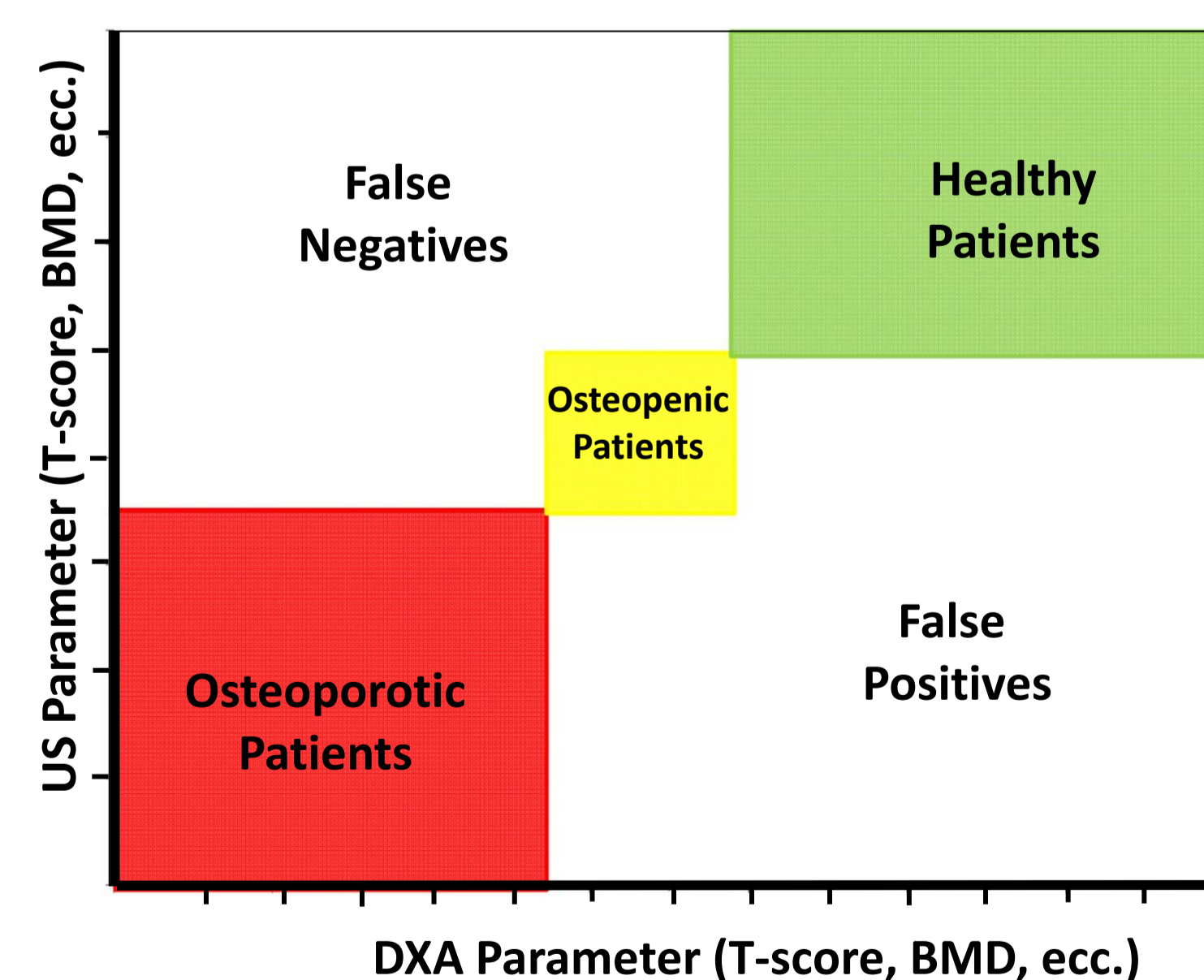
in order to perform spectral and statistical analyses on both US images and "raw" RF signals

#### BMD, T-score, Z-score

#### Diagnostic Accuracy Evaluation

through a direct comparison with DXA output as a function of patient age and BMI.

#### Evaluation Scheme

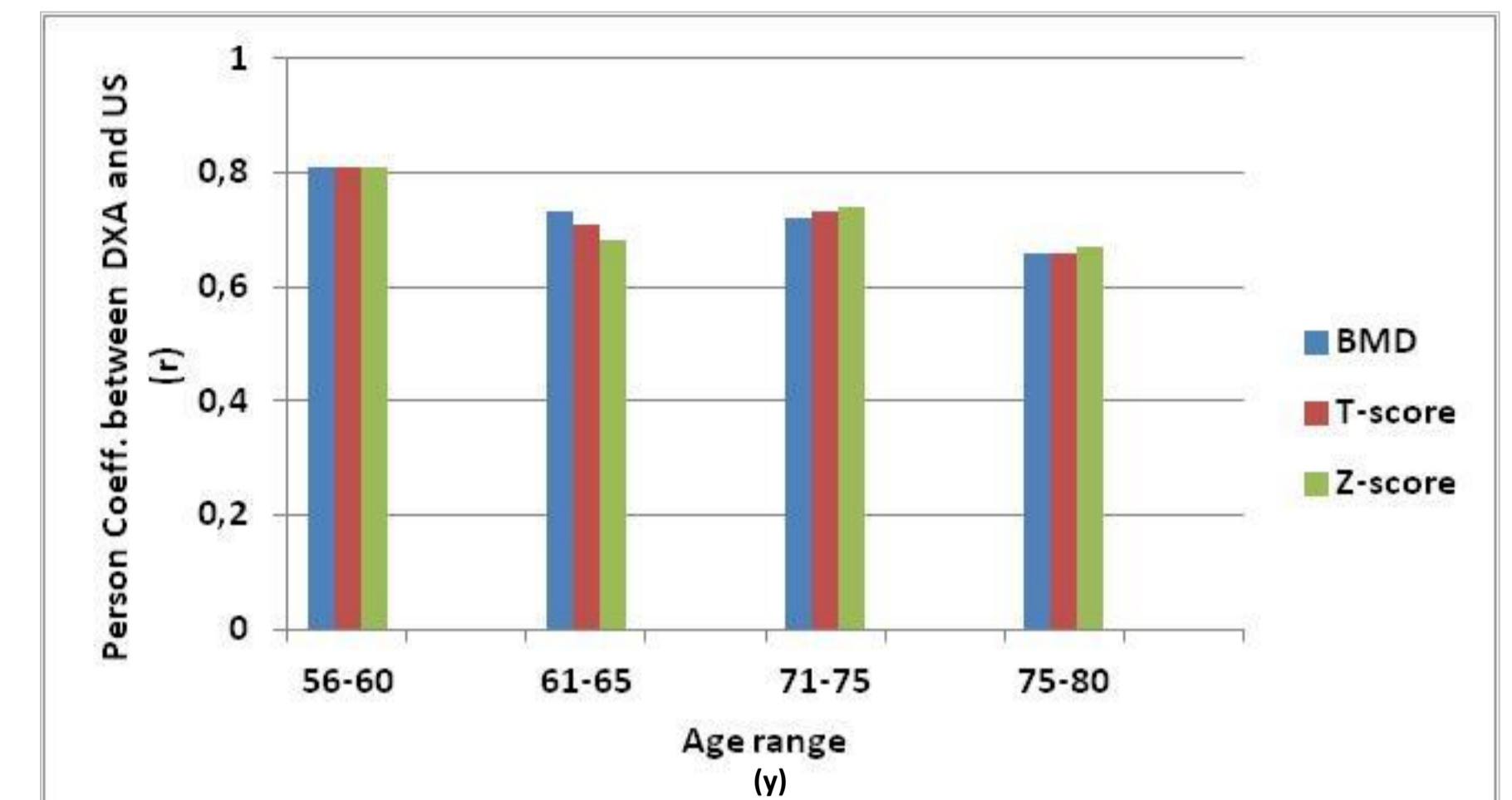


For 84.7% of the patients US diagnosis (osteoporotic, osteopenic, healthy) was the same of the corresponding DXA one ( $k = 0.713$ ,  $p < 0.0001$ ).

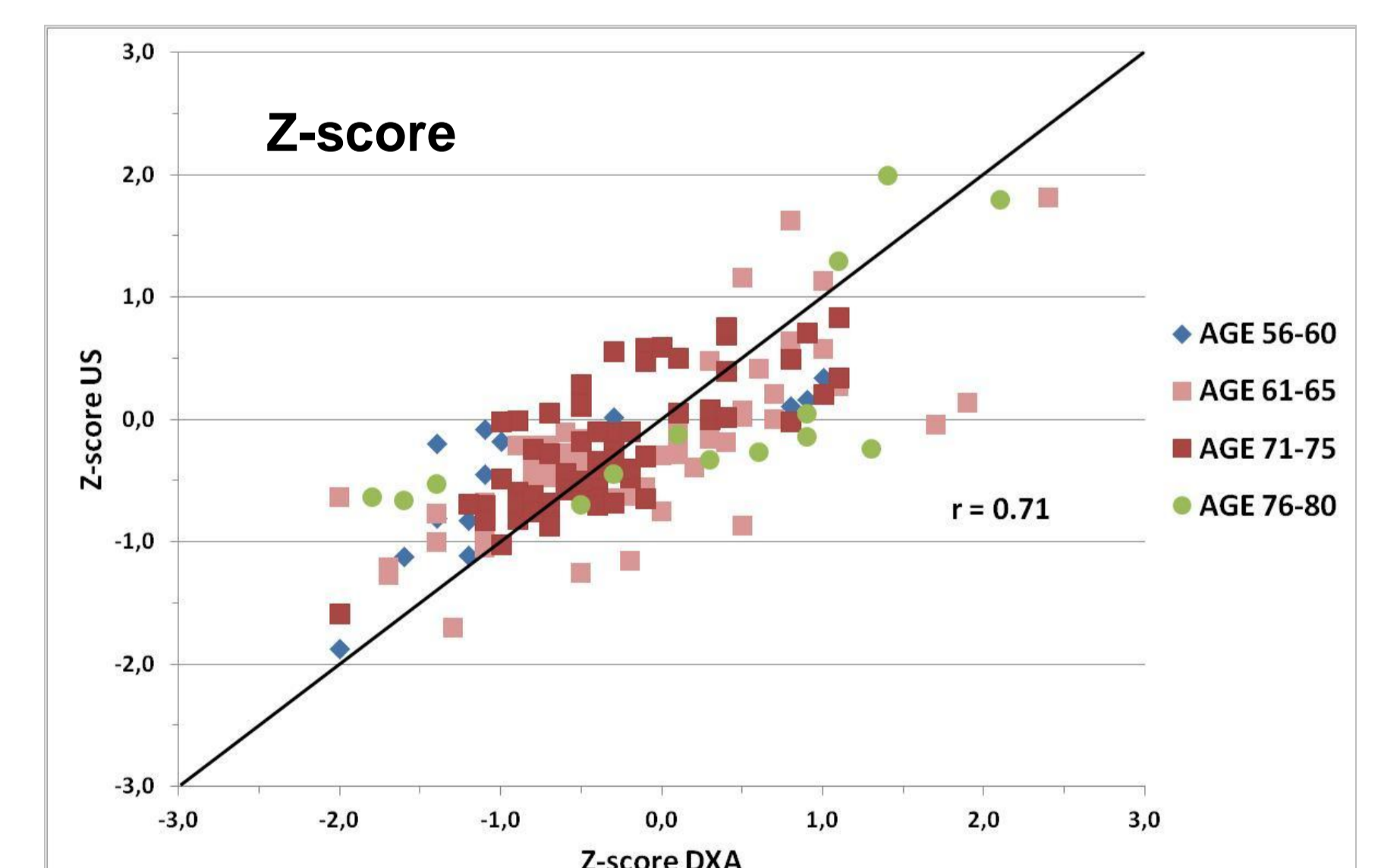
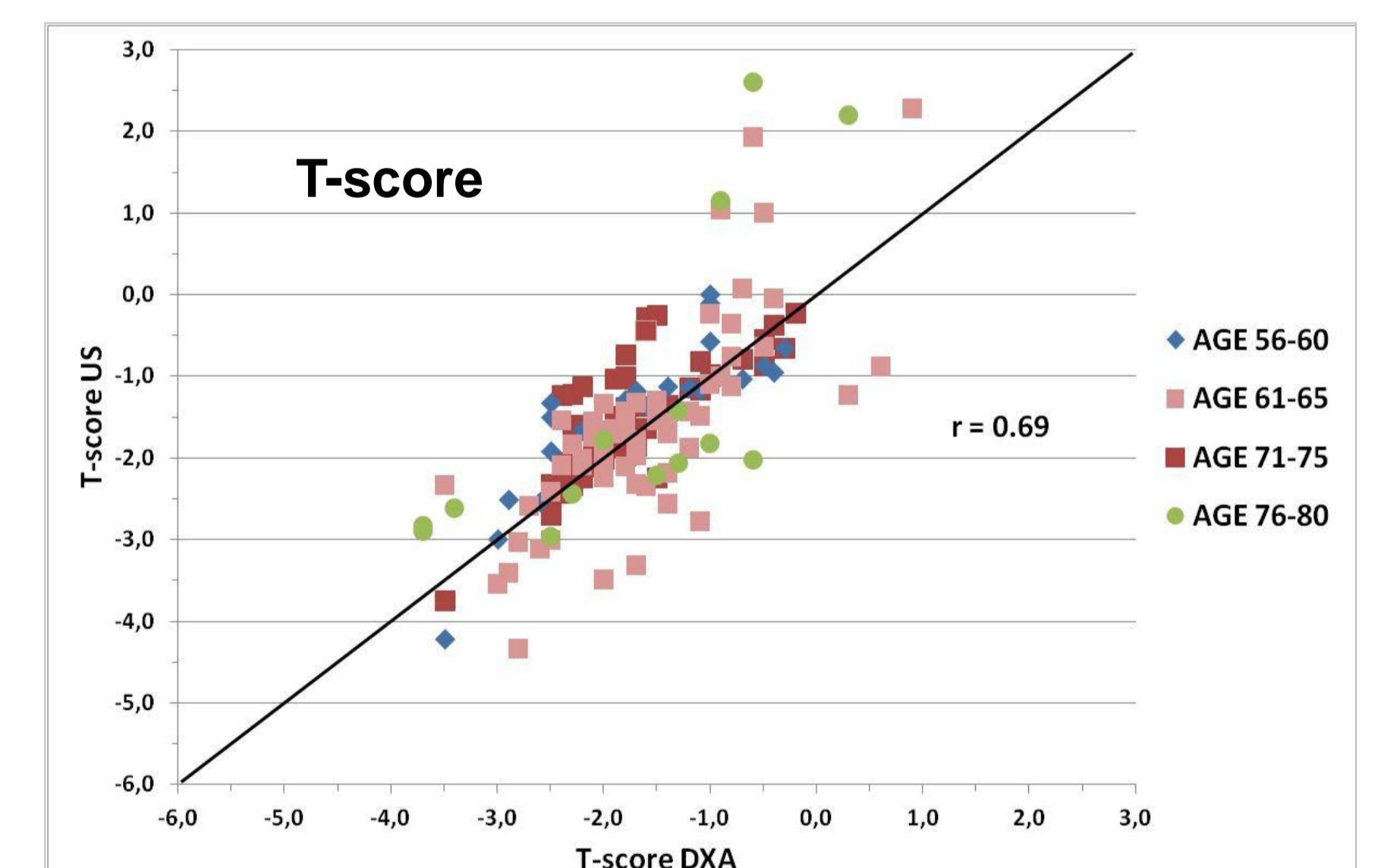
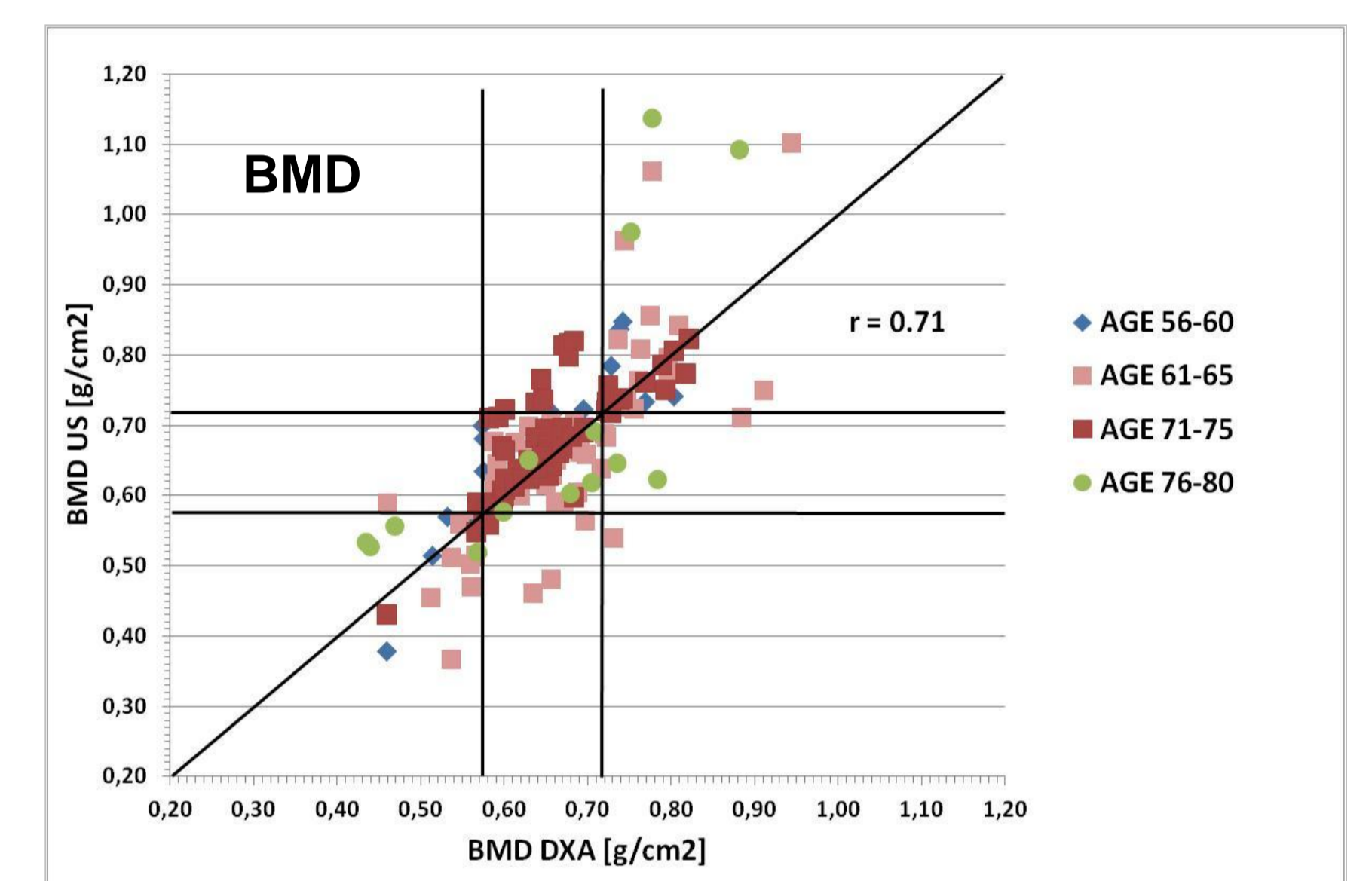
Pearson correlation coefficient ( $r$ ) between DXA and US measurements was evaluated for all diagnostic parameters (BMD, T-score, Z-score) for each patient categories (see histogram in the column next).

## Results

In particular for BMD parameter  $0.66 \leq r \leq 0.81$ ; for T-score  $0.66 \leq r \leq 0.81$  and for Z-score  $0.67 \leq r \leq 0.81$ .



As shown in Figures below, significant correlations were also found for single parameter:  $r = 0.71$  for BMD;  $r = 0.69$  for T-score;  $r = 0.71$  for Z-score. There were no appreciable variations in diagnostic agreement as a function of patient's body mass index (BMI).



## Conclusions

The adopted method for US densitometry of the proximal femur showed a significant diagnostic agreement with the corresponding DXA measurements.

Therefore, this approach has the potential to be used for early osteoporosis diagnosis and hip fracture prevention through population screening programs.

