Effect of Using Updated NHANES Data on Osteoporosis Diagnosis

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ABSTRACT

Previous consensus supported using manufacturer-specific equations to standardize NHANES data as the database for total femur T-score derivation. Recently, it was advocated that new correction equations be applied to allow database standardization at the femoral subregions. Consistent with this, GE Lunar updated the NHANES values in their database.

To evaluate the effect of this update, we compared GE Lunar Prodigy femur scans autoanalzyed using software prior to (v6.60/ 6.70) and after (v7.53) the NHANES update. The study population included 115 community-dwelling women; mean age/ weight of 65.6 years/ 156 pounds.

At all femoral sites, no BMD (grams/ cm^2) difference was observed between old and new software and T-scores were highly correlated ($r^2 > 0.99$). Additionally, the total femur T-score did not differ when analyzed with either software version. However, substantial T-score bias was present at the femur neck and trochanter with lower values consistently found using the updated software. Specifically, the mean T-score was 0.5 and 0.7 lower ($p < 0.001$) at the femoral neck and trochanter respectively. Consequently, in this unselected population, osteoporosis prevalence was 8% prior to, but 18% following, the update. Moreover, applying NOF treatment recommendations, 16% met criteria to receive pharmaceutical therapy before, but 37% after, the update.

In conclusion, when making recommendations to alter the normative database, it is essential to consider their effect upon osteoporosis diagnosis and treatment. A mechanism should be developed by which an external body, perhaps ISCD, reviews the impact of database changes with densitometer manufacturers prior to their widespread implementation. The susceptibility of diagnostic and therapeutic cutpoints to database changes underscores the

INTRODUCTION

The normative database utilized for T-score derivation affects osteoporosis prevalence.[1] Recognizing the need for database standardization led Miller to propose creation of the "Mother of All Databases," a process which has not yet occurred.[2] However, the International Committee for Standards in Bone Measurement (ICSBM) published formulae to convert measured BMD into standardized BMD at the lumbar spine and total proximal femur.[3,4,5,6] Furthermore, the ICSBM agreed on a universal reference database for the femur based on NHANES III and worked to expand standardization to other anatomic sites.[6] Consistent with this, Lu et. al.,[7] recently developed equations allowing NHANES III database application to the femoral neck and trochanteric regions of interest and advocated their adoption. Subsequently, GE Lunar incorporated updated NHANES III data into their software releases beginning with enCORE version 7.0. As part of another study, our group recently appreciated that this database change impacted femoral neck and trochanteric T-scores. This current study evaluates the effect of this database update on osteoporosis prevalence in an

METHODS

Subjects
- Proximal femur scans from 115 postmenopausal women were randomly selected from a population who responded to newspaper advertising to obtain a spine and hip DXA scan
- Age and weight; mean (range) 65.6 (42.9-90.3) years, 156 (100-275) pounds

Densitometers/Data Acquisition and Analysis
- All scans were obtained on a single GE Lunar Prodigy densitometer using software versions 6.60 or 6.70
- A single lumbar spine and left proximal femur scan were obtained on all subjects using "classical" positioning
- Autoanalysis was performed on all proximal femur scans
- Subsequently, all proximal femur scans were placed on removable media and taken to a newer Prodigy instrument where autoanalysis was repeated using software version 7.53

Statistical Analyses
- Subject measured BMD and derived T-scores using the "old" versus "new" software were compared utilizing linear regression (Statview, Cary, NC) and Bland Altman (Analyze-it, Leeds, UK) analyses
- The effects of database utilized on WHO diagnostic categorization and treatment recommendation using NOF criteria were evaluated using McNemar's test (Analyze-it, Leeds, UK)

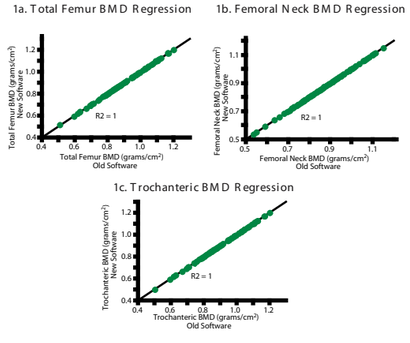

Figure 1a/b/c: Comparison of Femur Subregion BMD; New vs. Old Software. The BMD (grams/ cm^2) at all femoral subregions was essentially identical utilizing either the old or new software.

RESULTS

Proximal Femur BMD Comparison
- The measured BMD at the total femur, femoral neck and trochanteric regions was virtually identical (Figures 1a-c) using the "old" and "new" software
- In three subjects, the total femur BMD differed by 0.001 grams/ cm^2; in one of these the trochanteric BMD also differed by 0.001 grams/ cm^2
- In all of the other subjects, measured BMD at all three femoral subregions was identical

Proximal Femur T-score Comparison
- Total proximal femur T-scores derived using the new database did not differ from those derived using the old (Figure 2a/ b)
- However, at the femoral neck and trochanteric regions, all subjects had a lower T-score using the new software (Figures 3a/ b and 4a/ b)
- The mean T-score decrease resulting from use of the new software was 0.5 at the femoral neck and 0.7 at the trochanter

Effect of Database on Osteoporosis Prevalence and Treatment Recommendation
- Diagnostic categorization by database utilized (Figure 5a)

	Old Database	New Database
Normal	39%	19%
Osteopenia	53%	63%
Osteoporosis	8%	18%

- Applying the NOF treatment recommendation (pharmaceutical treatment is indicated at a T-score of -2.0) to this population, treatment would be indicated in 15.7% using the old database, but 36.5% with the new (Figure 5b)

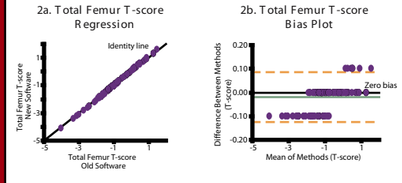

Figure 2a/b: Total Proximal Femur T-score Comparison Between the Old and New Software. No significant bias (0.02 T-score) was present at the total femur ROI following the NHANES update.

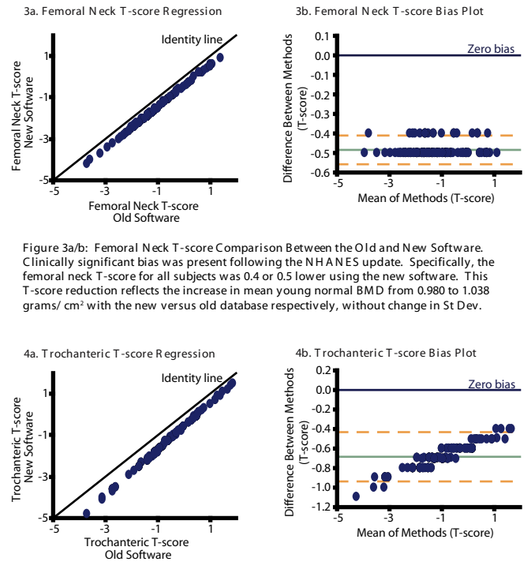

Figure 3a/b: Femoral Neck T-score Comparison Between the Old and New Software. Clinically significant bias was present following the NHANES update. Specifically, the femoral neck T-score for all subjects was 0.4 or 0.5 lower using the new software. This T-score reduction reflects the increase in mean young normal BMD from 0.980 to 1.038 grams/ cm^2 with the new versus old database respectively, without change in St Dev.

Figure 4a/b: Trochanteric T-score Comparison Between the Old and New Software. Clinically significant bias was present following the NHANES update. Specifically, the trochanteric T-score for all subjects was 0.4 to 1.1 lower using the new software. This T-score reduction reflects an increase in mean young normal BMD from 0.790 to 0.851 grams/ cm^2 and a reduction in standard deviation from 0.110 to 0.099 grams/ cm^2 with the new versus old database respectively.

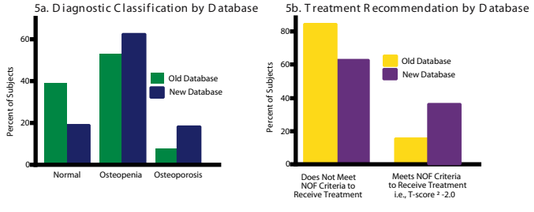

Figure 5a/b: Effect of Database on Bone Mass Categorization and Treatment Recommendation. Using the new database, substantially more ($p < 0.001$) of these women are classified as osteopenic or osteoporotic. Additionally, the number meeting the NOF guideline to receive medical therapy was more than doubled ($p < 0.001$).

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DISCUSSION

Previous observations clearly demonstrate the importance of utilizing a standard normative database for T-score derivation. However, acquisition of NHANES data exclusively using Hologic densitometers initially precluded database standardization between densitometers produced by different manufacturers. Previously, GE Lunar utilized available formulae to transform and incorporate NHANES III data into their normative database for total femur measurement. More recently, when additional formulae became available, GE Lunar likewise integrated NHANES III data into their femoral neck and trochanteric regions normative database. Not unexpectedly, such changes have resulted in excellent T-score agreement between Hologic and GE Lunar densitometers, not only at the total femur (Poster 117), but at the femoral neck and trochanteric regions as well (personal communication, Poster 117 authors). However, the impact of incorporating NHANES III data into the GE Lunar normative database for femoral neck and trochanteric T-score derivation on the diagnosis of low bone mass has not been explored.

This study demonstrates that incorporating NHANES III data at the femoral neck and trochanter has substantial bearing on osteoporosis diagnosis, assessment of disease progression and treatment.

As this database update leads to derivation of lower T-scores:

1. Physicians will appropriately recognize low bone mass in more women undergoing initial screening exams and will advise a greater number of women to follow osteoporosis preventive regimens.
2. Some women, in whom bone mass is monitored over time, will have modification of their diagnosis to a more severe category despite stable BMD. Such individuals should be advised that an improvement in diagnostic criteria, not a worsening of their condition, has occurred.
3. Occasional individuals receiving osteoporosis preventive therapy could, on follow-up BMD measurement, have an increase in bone mass, but worsening of their diagnostic categorization from osteopenia to osteoporosis.
   a. This "worsening" of diagnostic status is simply a phenomenon of the database change and should not promote patient anxiety or lead to changes in therapeutic regimen.
   b. It is incumbent upon ISCD and GE Lunar to make clinicians aware of this possibility.

Finally, this study emphasizes that the T-score based system of diagnosis is severely compromised. Specifically, diagnosis and treatment recommendations for patients with osteopenia/ osteoporosis depend upon the mean and standard deviation of BMD in a population of young normal adults, values which may vary substantially if different populations are used to construct the normative database. Hence, change in diagnosis with time will continue to occur with introduction of new bone mass measurement instruments and with any future changes in normative databases.

Thus, adoption of an alternative diagnostic system, preferably one based upon future fracture risk, should be encouraged and, in fact, expedited.