



**Incidence and predictive factors
associated with loss of bone mineral density
in bariatric surgery patients:
Retrospective cohort studies in thailand**

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The best method
for obtaining and sustaining
significant weight loss is **obesity surgery**

Impact of Bariatric Surgery on Bone Mineral Density: Observational Study of 110 Patients Followed up in a Specialized Center for the Treatment of Obesity in France

Marion Geoffroy^{1,2}  • Isabelle Charlot-Lambrecht¹ • Jan Chrusciel³ • Isabelle Gaubil-Kaladjian⁴ • Ana Diaz-Cives⁵ • Jean-Paul Eschard¹ • Jean-Hugues Salmon^{1,6}

Bariatric Surgery Results in Cortical Bone Loss

Emily M. Stein, Angela Carrelli, Polly Young, Mariana Bucovsky, Chiyuan Zhang, Beth Schrope, Marc Bessler, Bin Zhou, Ji Wang, X. Edward Guo, Donald J. McMahon, and Shonni J. Silverberg

Department of Medicine/Endocrinology (E.M.S., A.C., P.Y., M.Bu., C.Z., D.J.M., S.J.S.), and Surgery (B.S., M.Be.), Columbia University of Physicians and Surgeons, New York, New York 10032; and Bone Bioengineering Laboratory (B.Z., J.W., X.E.G.), Department of Biomedical Engineering, Columbia University, New York, New York 10027

Numerous studies have investigated the impact of bariatric surgery on BMD
(lack of studies for Asian population)

Bariatric Surgery: What the Rheumatologist Needs to Know

Sobia Hassan and Chandra Hassan

The Journal of Rheumatology June 2016, 43 (6) 1001-1007; DOI: <https://doi.org/10.3899/jrheum.160075>

Effects of obesity treatments on bone mineral density, bone turnover and fracture risk in adults with overweight or obesity

Claudia Harper, Andrea L. Pattinson, Hamish A. Fernando, Jessica Zibellini, Radhika V. Seimon and Amanda Sainsbury

Changes in Bone Metabolism in Morbidly Obese Patients After Bariatric Surgery: A Meta-Analysis

Cong Liu¹ • Dan Wu² • Jing-Fan Zhang¹ • Duo Xu¹ • Wan-Feng Xu¹ • Yu Chen¹ • Bing-Yang Liu¹ • Ping Li¹ • Ling Li¹

BMI Cut Points to Identify At-Risk Asian Americans for Type 2 Diabetes Screening

William C. Hsu,¹
Maria Rosario G. Araneta,²
Alka M. Kanaya,³ Jane L. Chiang,⁴
and Wilfred Fujimoto⁵

Diabetes Care 2015;38:150–158 | DOI: 10.2337/dc14-2391

Individuals with **Southeast Asian heritage**, the BMI criteria can be lowered by 2.5 kg/m² per class, related to a **higher prevalence of truncal obesity (visceral fat)**, which is felt to be more hazardous than peripherally located fat.



BMI ≥ 37.5 kg/m² with or without comorbid illness

BMI ≥ 32.5 with obesity related co-morbid disease



- **Primary outcome:**
 - **Incidence** of clinically significant **BMD loss** at 1 and 2 years after bariatric surgery
- **Secondary outcome:**
 - To identify **factors associated** with clinically significant **reduction in BMD** after bariatric surgery
 - **Prevalence and incidence of osteoporosis** in obesity patients treated by bariatric surgery



Retrospective study

Inclusion criteria

- Patient who undergone bariatric surgery (LSG or LRYGB) at SECOMS between February 2012 and March 2021

Exclusion criteria

- Not available for BMD pre and postoperative
- Incomplete laboratory for bone metabolism (Ca, P, VitD, PTH)
- Follow up time less than 1 year
- Others than LSG, and LRYGB



Between February 2012 and March 2021

256 patients



**82 patients were excluded:
Not available for BMD at 1 and/or 2 year postoperative**

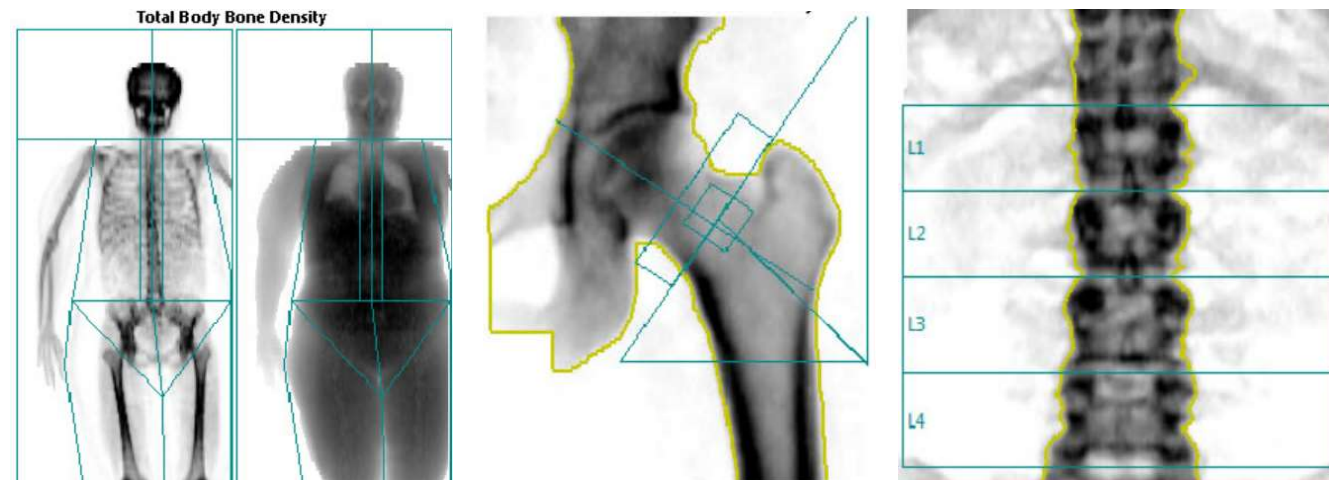
174 patients at 1 year postop



87 patients at 2 year postop

PSU

DEXA scan: GE healthcare Lunar (Prodigy advance)





Original Article

Follow-up of Individual Patients on Two DXA Scanners of the Same Manufacturer

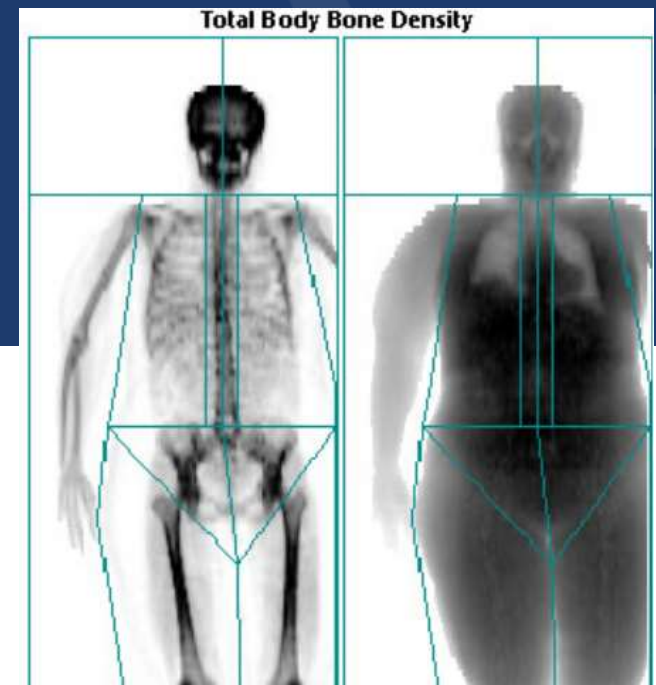
S. Kolta, P. Ravaud, J. Fechtenbaum, M. Dougados and C. Roux

Centre d'Evaluation des Maladies Osseuses, Hôpital Cochin, Paris, France

$$CV = \frac{SD}{\text{mean}} \times 100$$



Smallest detectable difference(SDD) = 1.96 SD

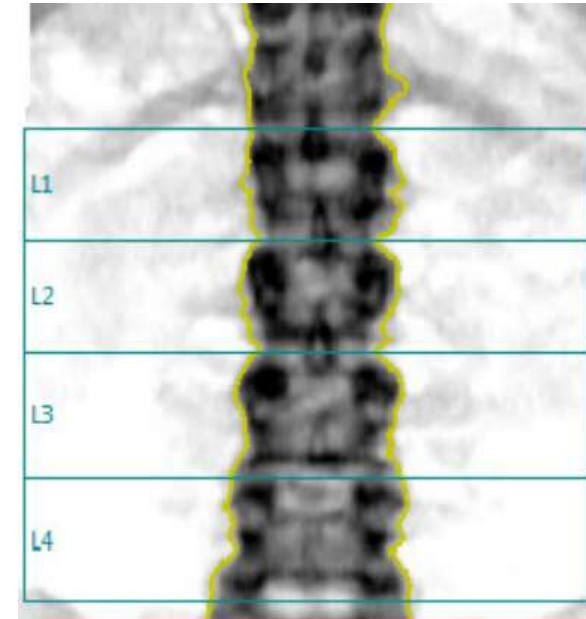
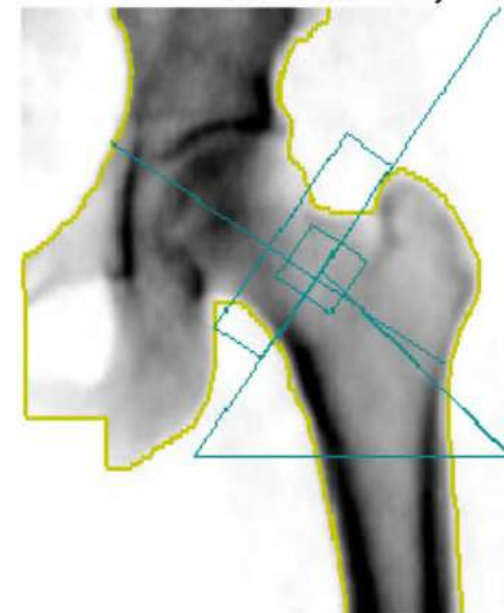


Smallest detectable difference (SDD) = 1.96 SD



Cut point for least significant change

- **Femur: 0.03 gm/cm²**
- **Lumbar spine: 0.015 gm/cm²**
- **Total body: 0.03 gm/cm²**





Statistical analysis

- **A multivariable analysis was performed using logistic regression to identify factors associated with a clinically significant BMD loss after bariatric surgery.**
- **Variables with a p value < 0.20 in the univariate analysis were included in the model**
- **p values < 0.05 were considered statistically significant.**
- **All analyses were performed with R version 4.2.1**

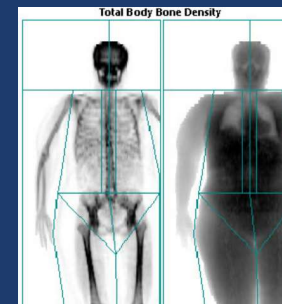
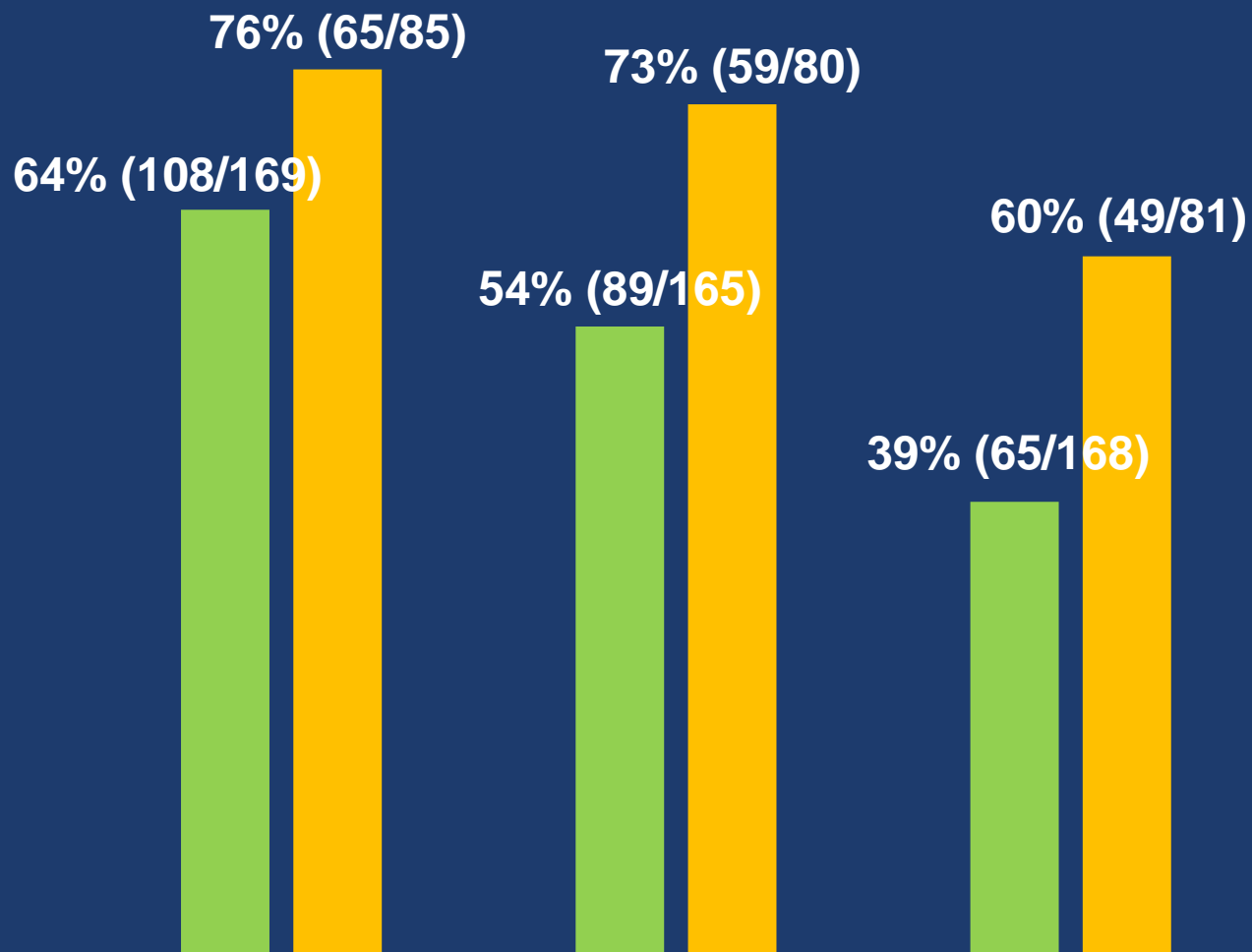
Baseline characteristics

Total (patients)	174
Age, year old (mean, SD)	38.3 (11.7)
Sex (number, %)	Female 130 (74.7)
	Male 44 (25.7)
Type of surgery (number, %)	LSG 127 (73)
	LRYGB 47 (27)
Ca preop level (mean, SD)	9.2 (0.4)
Phosphorus preop level (mean, SD)	3.6 (0.5)
Total vitamin level preop (mean, SD)	22.9 (6.8)
PTH preop level (mean, SD)	51.4 (26.9)
% fat mass preoperative (mean, SD)	48.9 (4.5)
Lean mass preoperative (mean, gm)	58629.9 (11233)

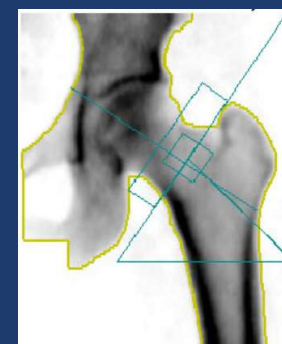
Total (patients)	174
Diabetes mellitus (%)	28.2
Hypertension (%)	40.2
Dyslipidemia (%)	81
OSA (%)	93.7
Fatty liver (%)	95.9
Alcohol drinking (%)	2.9
Smoking (%)	2.9
Menopausal status (%)	15.1

Incidence clinically significant BMD loss post bariatric procedure

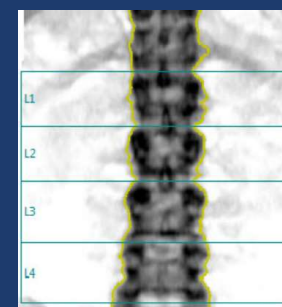
Incidence of clinically significant BMD loss (%)



↓ $\geq 0.03 \text{ gm/cm}^2$



↓ $\geq 0.03 \text{ gm/cm}^2$



↓ $\geq 0.015 \text{ gm/cm}^2$

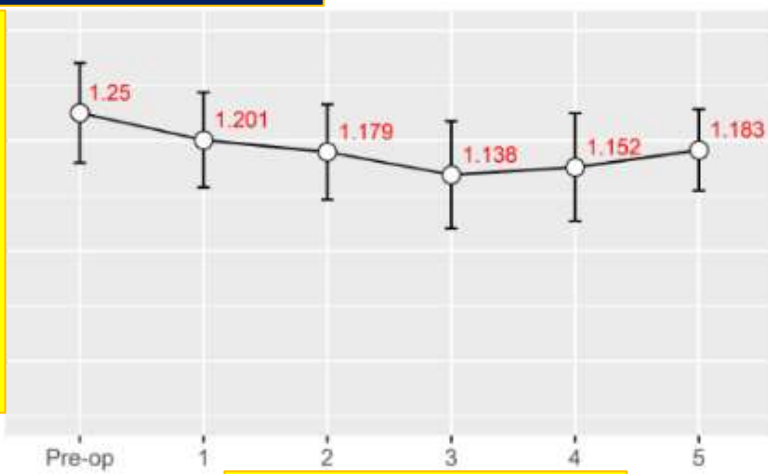
■ 1 year post operation
■ 2 year post operation

	Total body	Femoral neck	Lumbar spine
1 year post operation	64%	54%	39%
2 year post operation	76%	73%	60%

Average BMD (extend to 5 years postop)

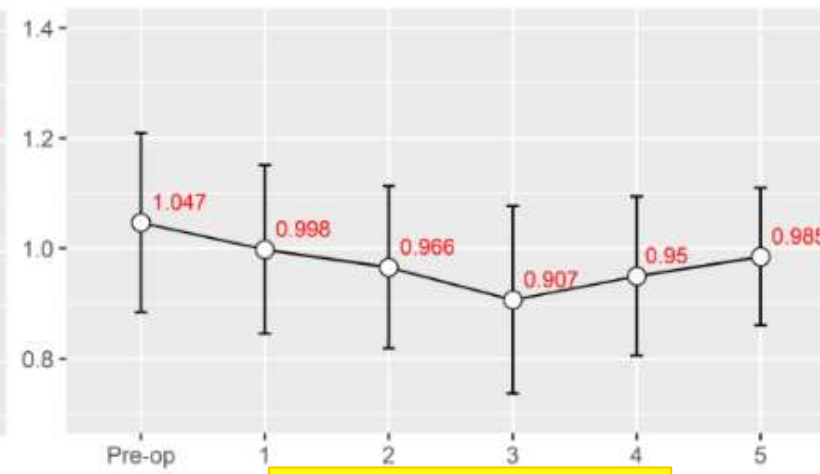
Total body

BMD (g/cm²)



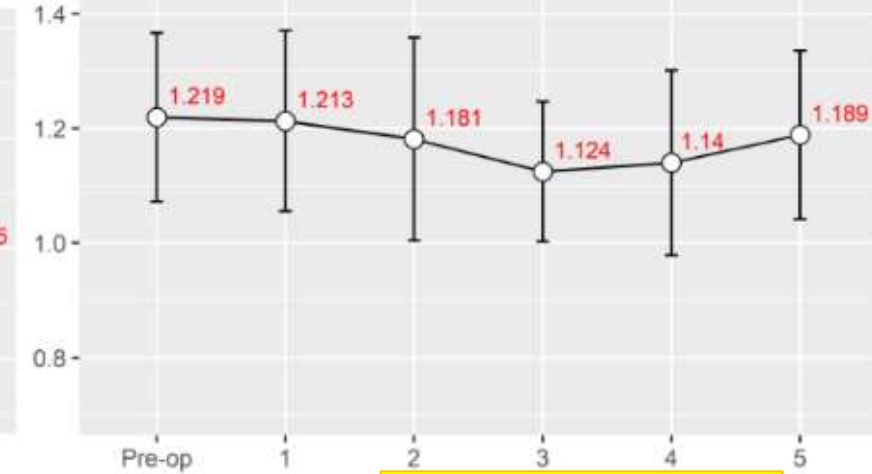
Postop (year)

Femoral neck



Postop (year)

Lumbar spine



Postop (year)

1 year: N=174

2 year: N=87

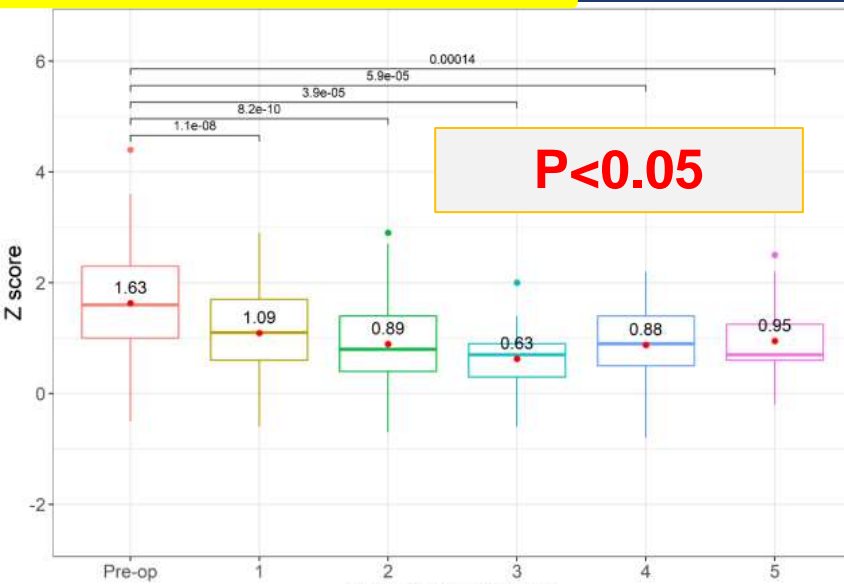
3 year: N=16

4 year: N=27

5 year: N=24

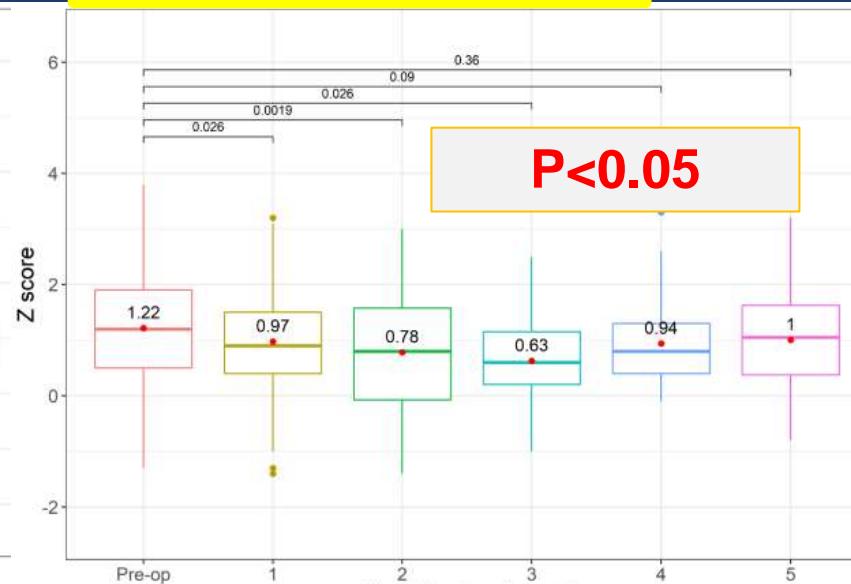
Age-match Z score compares BMD to someone of equivalent age (extend to 5 year post bariatric)

Total body



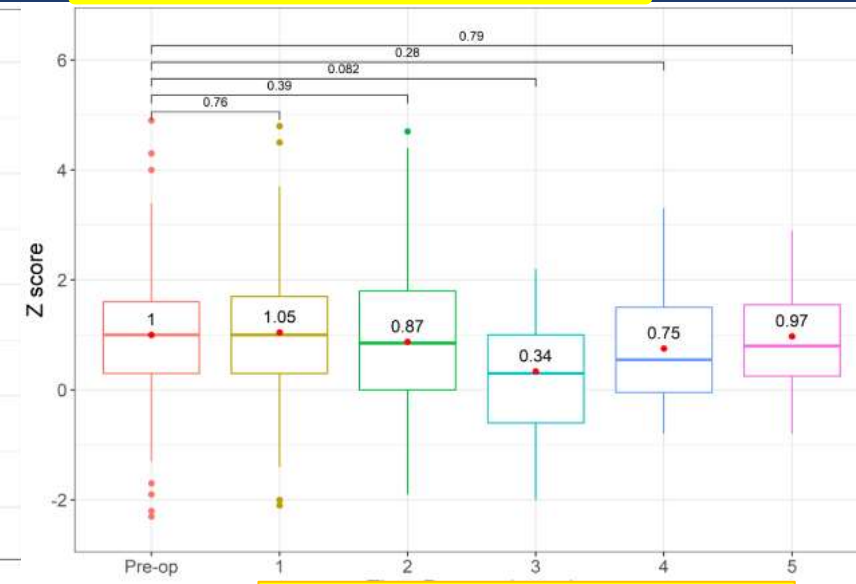
Pre/Postop (year)

Femural neck

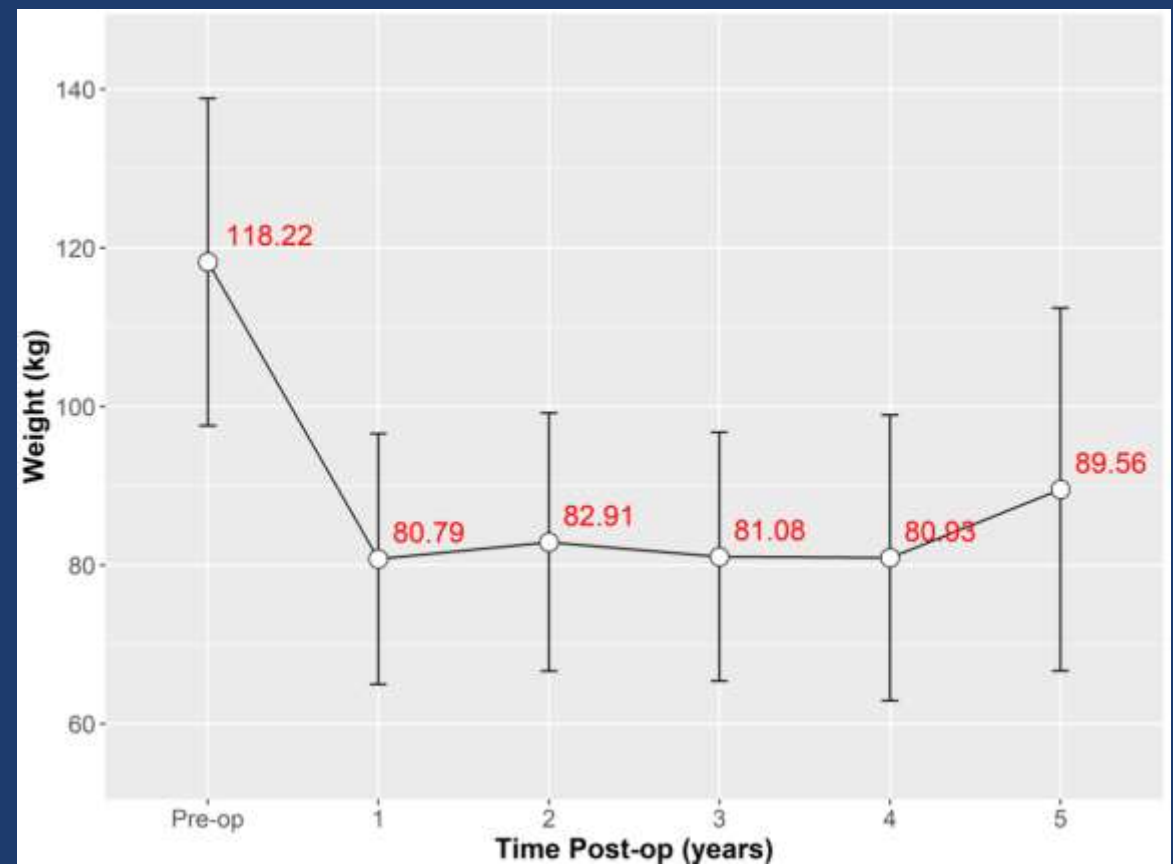
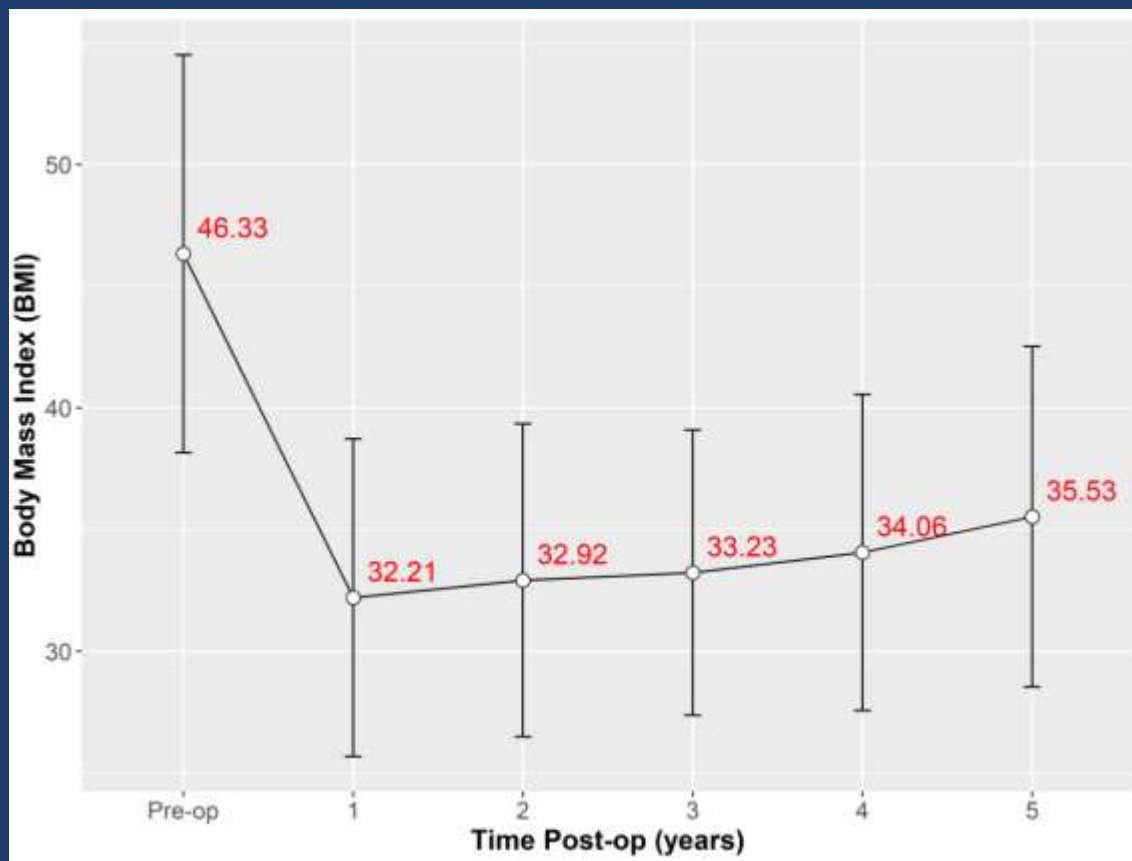


Pre/Postop (year)

Lumbar



Pre/Postop (year)



1 year: N=174

2 year: N=87

3 year: N=16

4 year: N=27

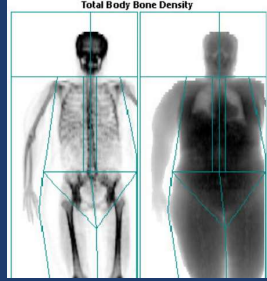
5 year: N=24

Total body :Cut point > 0.03 gm/cm ²	No significant BMD loss at 2 year post bariatric	Significant BMD loss at 2 year post bariatric	Univariate analysis		Multivariate analysis	
			OR (95% CI)	P value	OR (95% CI)	P value
Patients (%)	20/65 (24%)	65/85 (76%)	-	-	-	-
Age, year (mean±SD)	39.7±11.9	41±11.9	-	0.669	-	-
Sex and men status, (%) Ref=female nonmenopause (FN), female menopause (FM), male (M)	FN 15 (75%) FM 1 (5%) M 4 (20%)	FN 32 (49.2%) FM 9 (13.8%) M 24 (36.9%)	-	0.123	-	-
Type of bariatric Sx (%) Ref=LSG	LRYGB 4 (20%) LSG 16 (80%)	LRYGB 23(35.4%) LSG 42 (64.6%)	-	0.309	-	-
Loss of weight, kg (mean±SD)	30.4±13.4	39.5±15	-	0.017	1.05	0.014
Loss of BMI, kg/m ² (mean±SD)	11.7±5	15.1±6.6	-	0.037	-	-
% Loss of fat mass (mean±SD)	36.9±14.4	43±16.9	-	0.15	-	-

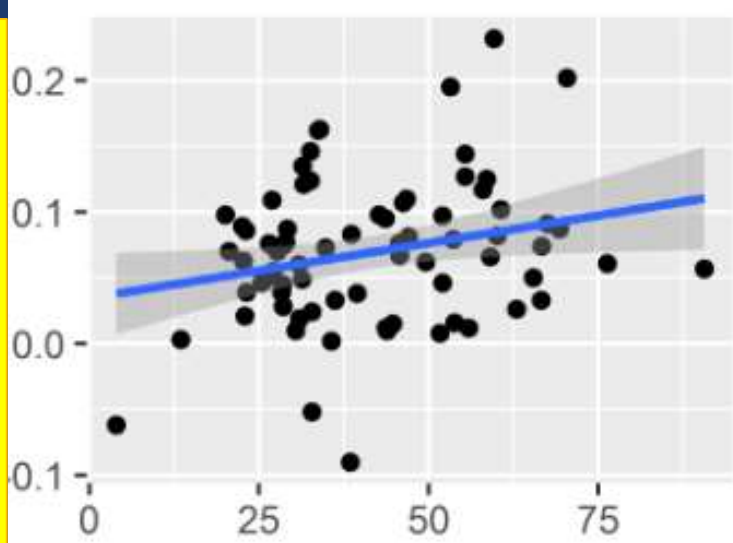
Femoral neck :Cut point > 0.03 gm/cm ²	No significant BMD loss at 2 year post bariatric	Significant BMD loss at 2 year post bariatric	Univariate analysis		Multivariate analysis	
			OR (95% CI)	P value	OR (95% CI)	P value
Patients (%)	21/80 (26%)	59/80 (74%)	-	-	-	-
Age, year (mean±SD)	36±10.7	42.3±11.9	1.05 (1,1.1)	0.034	1.07 (1.01,1.12)	0.01
Sex and men status, (%) Ref=female nonmenopause (FN), female menopause (FM), male (M)	FN 14 (66.7%) FM 1 (4.8%) M 6 (28.6%)	FN 30 (50.8%) FM 7 (11.9%) M 22 (37.3%)	-	0.402	-	-
Type of bariatric Sx (%) Ref=LSG	LRYGB 6 (28%) LSG 15 (72%)	LRYGB 18(30.5%) LSG 41 (69.5%)	-	1	-	-
Loss of weight, kg (mean±SD)	37.2±15.3	36.9±15.5	1 (0.97,1.03)	0.937	1.09 (0.98, 1.22)	0.078
Loss of BMI, kg/m ² (median,IQR)	11.5 (10,16.1)	12.2 (9.8,17.4)	0.98 (0.91, 1.06)	0.887	0.82 (0.65, 1.04)	0.085
% Loss of fat mass (mean±SD)	38.9±15.1	41.8±17	-	0.496	-	-

Lumbar spine :Cut point > 0.03 gm/cm ²	No significant BMD loss at 2 year post bariatric	Significant BMD loss at 2 year post bariatric	Univariate analysis		Multivariate analysis	
			OR (95% CI)	P value	OR (95% CI)	P value
Patients (%)	32/81 (40%)	49/81 (60%)	-	-	-	-
Age, year (mean±SD)	35.4±10.2	44.5±11.3	1.08(1.03, 1.13)	<0.001	1.09 (1.04,1.15)	<0.001
Sex and men status, (%) Ref=female nonmenopause (FN), female menopause (FM), male (M)	FN 19 (59.4%) FM 2 (6.2%) M 11 (28.6%)	FN 26 (53.1%) FM 7 (14.3%) M 16 (37.3%)	-	0.527	-	-
Type of bariatric Sx (%) Ref=LSG	LRYGB 6 (19%) LSG 26 (81%)	LRYGB 19(38.8%) LSG 30 (61.2%)	2.74 (0.95,7.9)	0.097	2.7 (0.78,9.34)	0.106
Loss of weight, kg (mean±SD)	33.9±15.3	39.1±15.1	-	0.138	-	-
Loss of BMI, kg/m ² (mean±SD)	12.3±5.4	15.3±7	-	0.04	-	-
% Loss of fat mass (mean±SD)	34.3±13	45.8±16.6	1.05(1.02, 1.09)	0.002	1.07 (1.02,1.11)	<0.001

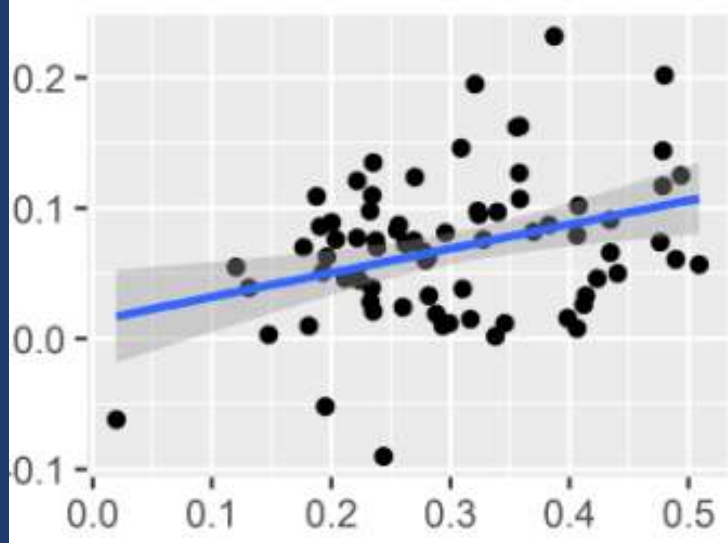
Total body (2 year post bariatric)



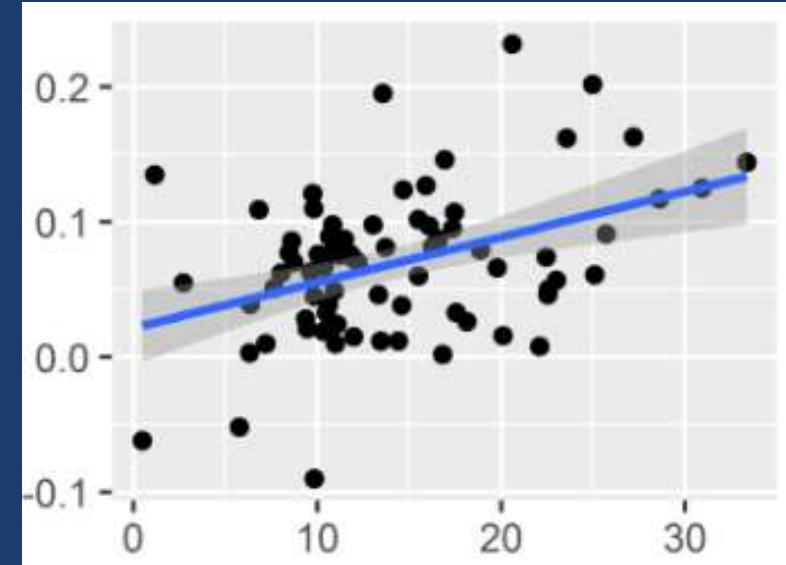
Loss of BMD (g/cm²)



Loss of fat mass (%)

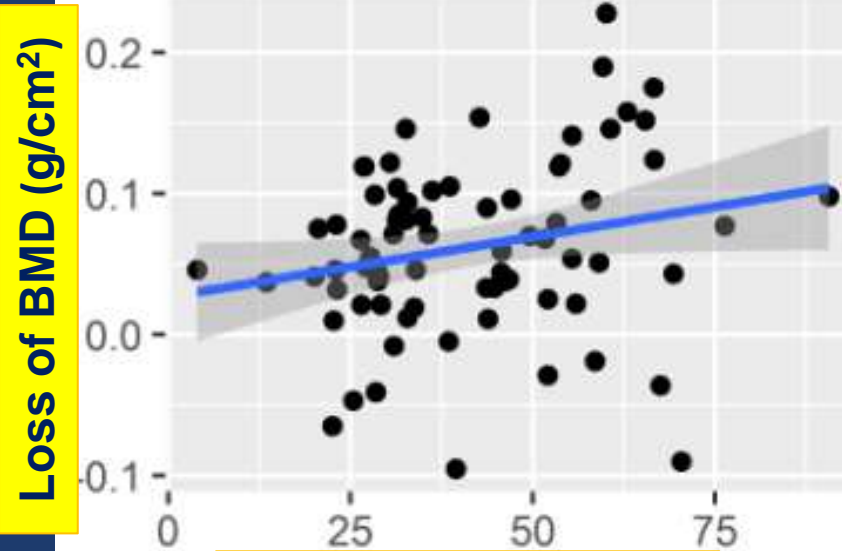
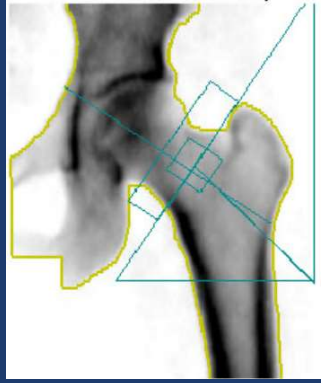


Loss of weight (proportion 0-1.0)

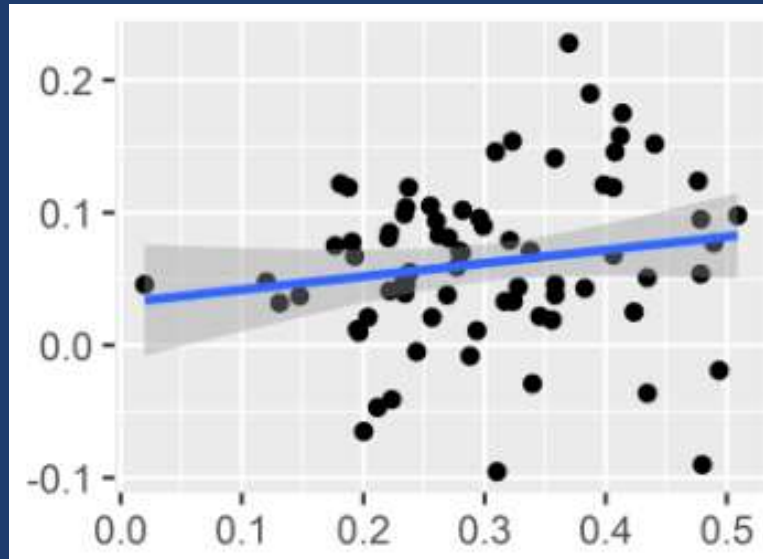


Loss of BMI (%)

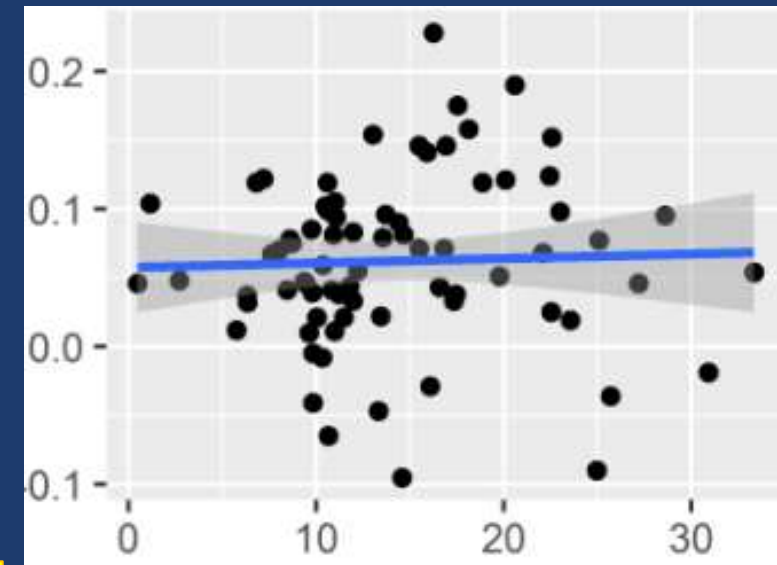
Femoral neck (2 year post bariatric)



Loss of fat mass (%)



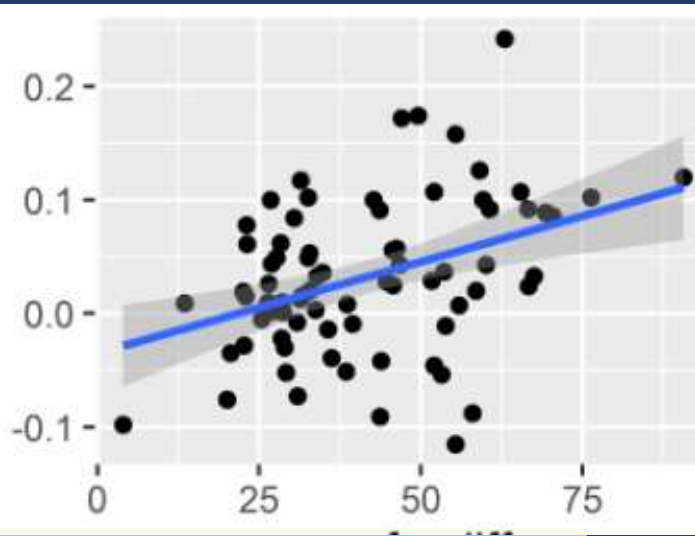
Loss of weight (proportion 0-1.0)



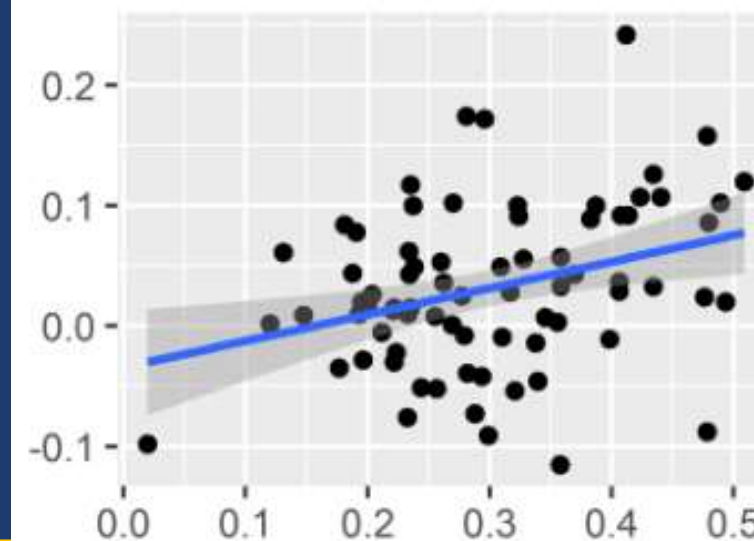
Loss of BMI (%)

Lumbar L1-4 (2 year post bariatric)

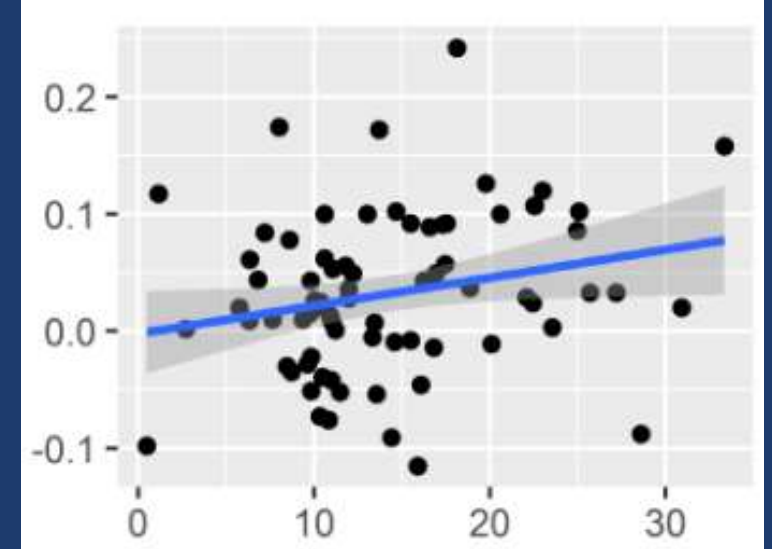
Loss of BMD (g/cm²)



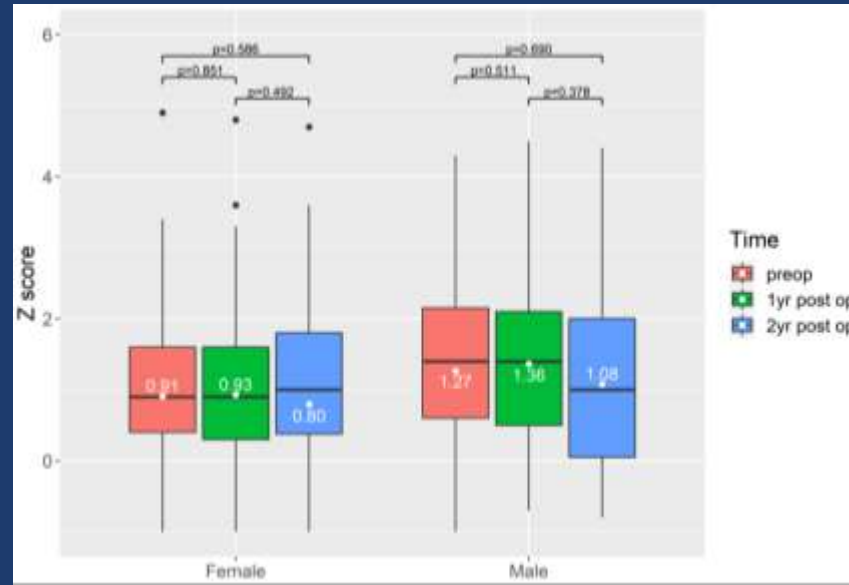
Loss of fat mass (%)



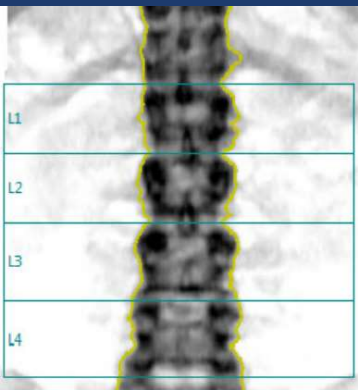
Loss of weight (proportion 0-1.0)



Loss of BMI (%)



Age-match Z score:
No statistic significant
for BMD loss at lumbar



Preop BMD (n=171)			BMD 1 year postop (n=171)			BMD 2 years postop (n=86)		
N	P	S	N	P	S	N	P	S
165	6	0	159	12	0	79	6	1
96%	4%	0%	93%	7%	0%	92%	7%	1%

Normal (N): T-score \geq -1 SD

Osteopenia (P): T-score -1 to -2.5 SD

Osteoporosis (S): T-score \leq -2.5 SD

Discussion

➤ BMD loss over the time after bariatric

Impact of Bariatric Surgery on Bone Mineral Density: Observational Study of 110 Patients Followed up in a Specialized Center for the Treatment of Obesity in France

Marion Geoffroy^{1,2} • Isabelle Charlot-Lambrecht¹ • Jan Chrusciel³ • Isabelle Gaubil-Kaladjian⁴ • Ana Diaz-Cives⁵ • Jean-Paul Eschard¹ • Jean-Hugues Salmon^{1,6}

Incidence and predictive factors associated with loss of bone mineral density in bariatric surgery patients: Retrospective cohort studies in thailand

- BMD loss at least one sites

Postop:

6 months: 62.1%

12 months: 71.6%

BMD measurement (g/cm ²)	Clinical significant loss of BMD post bariatric	
	1 year	2 year
Total body	64%	76%
Femural neck	54%	73%
Lumbar spine (L1-4)	39%	60%

Discussion



- Physiological adaptations or pathological ?
- BMD loss for lumbar spine post bariatric (Z-score ?)

Limitations

Retrospective study

The duration of follow-up was short

Small number of patients



Strength

Largest series for Asian populations



Conclusions

- **Bariatric surgery >>> BMD loss over the time after procedures**
- **Pathological osteoporosis was only one case over 2 year follow-up**
- **Physiologic or pathological process???**
- **Systematic nutrition supplement + follow-up by DEXA scan after bariatric procedures should be consider, particularly in**



Thank you

