

# Tooth loss and bone mineral density among women: a cross-sectional survey

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## Abstract

**Objective** We examined the association between total tooth loss and bone mineral density to determine whether the former can be used as a surrogate marker of the latter.

**Design** A community based cross-sectional survey.

**Setting** The community-study area of the Faculty of Medicine, Galle.

**Participants** A group of randomly selected 327 women volunteers aged 32 to 97 years.

**Measurements** Anthropometry, total number of teeth lost and bone mineral density (BMD) of the lumbar spine and proximal femur.

**Results** In categorical analysis, after adjusting for possible confounding factors, mean BMDs of the spine and proximal femur showed no significant differences in the thirds of the total tooth loss. In regression analysis, a loss of one tooth was negatively associated with spine BMD of premenopausal women by 0.003 g/cm<sup>2</sup> and the trochanteric BMD of postmenopausal and all women by 0.001 g/cm<sup>2</sup>. These associations, however, were not seen in other skeletal sites.

**Conclusions** Total tooth loss did not show a uniform and significant association with bone mineral density, measured at relevant skeletal sites. Total tooth loss as a surrogate

marker of low bone density cannot be justified in this population of women.

## Introduction

Osteoporosis and hip fractures are associated with increased morbidity and mortality in postmenopausal women and a sharp increase in the incidence of hip fractures is expected in future years [1]. Risk factors of osteoporosis or fragility fractures, detected in community surveys are used to select women for DXA scanning. Although the risk factors of osteoporosis and hip fractures vary in different countries [2], new risk factors are being added to screening programs [3].

Association between bone density and the indices of dental hygiene including tooth count has been examined previously. Most of these studies have been done in Caucasian women [4-7], and only limited studies have been done in Asian countries [8,9]. As women in Sri Lanka have social habits, eating patterns, hormone usage, physical activities different to Caucasian women, the associations observed in previous studies may be different among our women. This survey was done in southern Sri Lanka, using a group of randomly selected healthy women to examine the association between tooth loss and BMD.

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## Materials and methods

A group of 327 women volunteers, aged between 32–97 years, was selected randomly from the field training area of the Faculty of Medicine, Galle using the latest voter registers. Consenting volunteers were interviewed to gather information on current and past medical health including medications, and all were subjected to a detailed physical examination. Women with the history of chronic liver disease, endocrine disorder, epilepsy, chronic renal disease, or illnesses of inflammatory nature were excluded from the survey. Those who had taken systemic corticosteroids, thyroxine, heparin, hormone replacement therapy, vitamin D, thiazide diuretics or pharmacological doses of calcium were also excluded ( $n = 15$ ).

The total number of teeth lost in the past (total tooth loss) was confirmed by counting the remaining teeth. Social habits including smoking and alcohol consumption were recorded. BMDs of the non-dominant hip and the lumbar spine from L<sub>2</sub> to L<sub>4</sub> (antero-posterior projection) were measured using Norland Eclipse XR machine (Norland Corp, Ford Atkinson, USA). In vitro accuracy and precision of the machine were estimated each scanning day, by scanning the two phantoms provided by the manufacturer. In vivo precision error (coefficient of variation) of the machine was estimated earlier by repeating scans of 30 women on the same day and found to be 1.0%, 1.49% and 2.17% for the lumbar spine, femoral neck and trochanteric area.

## Statistical analysis

Descriptive data of the study group are given either as mean (standard deviations) or numbers (percentages) unless stated otherwise. Associations between the total tooth loss and BMDs at the spine, femoral neck and trochanteric area were examined using linear regression analysis, initially adjusted for age and then for other possible confounders (weight, height and years since menopause). We did not adjust for smoking habits or alcohol consumption as none of the women in our sample ever smoked or consumed alcohol. Regression analyses were done, initially for the entire sample and then for postmenopausal and premenopausal subgroups. Mean BMDs of the thirds of the total tooth loss were examined using ANOVA, after adjusting for possible covariates. This was done for the entire sample and the postmenopausal subgroup, but not for the premenopausal subgroup as the number of women in the premenopausal subgroup was insufficient. Statistical significance was defined as  $p$  (two-tailed)  $< 0.05$  for all analyses and SPSS version 10 for Windows was used for all statistical calculations.

Approval for the study was obtained from the local ethics committee. Informed written consent was given by each individual at the beginning of the study.

## Results

Age of the women in the study ranged from 32 to 97 with mean of 56.9 (12.9) years. Seven (2.1%) of them were

Table 1. Descriptive data of 327 women volunteers

Measurement	Mean	Standard deviation
Age (years)	56.9	12.9
Height (m)	1.48	0.06
Weight (kg)	47.8	10.1
Age at menarche (years)	14.0	1.54
Age at menopause (years)	47.8	4.10
Years since menopause (years)	16.5	9.30
Spine BMD (g/cm <sup>2</sup> ) ( $n = 314$ )	0.784	0.186
Femoral neck BMD (g/cm <sup>2</sup> )	0.694	0.148
Trochanteric area BMD (g/cm <sup>2</sup> )	0.563	0.120

Table 2. Regression analysis between total tooth loss and BMDs in all women and subgroups of postmenopausal and premenopausal women

	Coefficient	Standard error	$p$ value
<i>All women</i>			
Spine BMD*	-0.002	0.001	0.06
Femoral neck BMD*	-0.001	0.001	0.27
Trochanteric BMD*	-0.001	0.001	0.04
<i>Postmenopausal women</i>			
Spine BMD*	-0.001	0.001	0.45
Femoral neck BMD*	-0.001	0.001	0.21
Trochanteric BMD*	-0.001	0.001	0.02
<i>Premenopausal women</i>			
Spine BMD**	-0.003	0.001	0.04
Femoral neck BMD**	-0.001	0.001	0.83
Trochanteric BMD**	-0.001	0.001	0.69

\*Adjusted for age, height, weight and years since menopause

\*\*Adjusted for age, height and weight

edentulous, 42 (21.8%) had complete dentate, whereas median total tooth loss was 18 (8–28). 200 (61.2%) women were postmenopausal (Table 1).

Table 2 shows the regression analysis between the total tooth loss and BMDs in the spine and proximal femur in the entire sample and postmenopausal and premenopausal subgroups. Although inverse association was seen between total tooth loss and BMD in general, most of the values did not show a statistical significance. In regression analysis, a loss of one tooth was negatively associated with spine BMD in premenopausal women by 0.003 g/cm<sup>2</sup> and the trochanteric BMD in postmenopausal and all women by 0.001 g/cm<sup>2</sup> and these two associations were statistically significant.

Mean BMD values, adjusted for age, weight, height and years since menopause, in the thirds of the total tooth loss are shown in Table 3. In general, BMDs showed no association with the total tooth loss in this categorical analysis. In all women, however, the highest trochanteric BMD was seen among women who lost the least number of teeth while the lowest BMD was seen among the women who lost the most number of teeth. Same pattern was seen in the spine BMD in premenopausal women. The BMD



Table 3. Mean (SD) BMDs in the thirds of the total tooth loss

	The upper third of the TTL (n = 109)	The middle third of the TTL (n = 107)	The lower third of the TTL (n = 110)	p value
Number of tooth lost	5.7 (3.3)	18.6 (4.1)	30.0 (2.2)	—
<i>Spine BMD (g/cm<sup>2</sup>)</i>				
All women*	0.811 (0.013)	0.758 (0.012)	0.776 (0.013)	0.01
Postmenopausal*	0.700 (0.014)	0.665 (0.015)	0.699 (0.014)	0.16
Premenopausal**	0.990 (0.022)	0.943 (0.020)	0.916 (0.022)	0.07
<i>Femoral neck BMD (g/cm<sup>2</sup>)</i>				
All women*	0.702 (0.010)	0.695 (0.010)	0.686 (0.011)	0.63
Postmenopausal*	0.641 (0.014)	0.613 (0.011)	0.631 (0.011)	0.16
Premenopausal**	0.820 (0.019)	0.792 (0.018)	0.819 (0.019)	0.48
<i>Trochanteric BMD (g/cm<sup>2</sup>)</i>				
All women*	0.576 (0.009)	0.572 (0.008)	0.549 (0.009)	0.09
Postmenopausal*	0.541 (0.009)	0.496 (0.009)	0.517 (0.009)	0.002
Premenopausal**	0.655 (0.016)	0.639 (0.015)	0.653 (0.016)	0.73
<i>Ward's triangle BMD (g/cm<sup>2</sup>)</i>				
All women*	0.501 (0.011)	0.509 (0.010)	0.499 (0.011)	0.77
Postmenopausal*	0.458 (0.011)	0.420 (0.011)	0.443 (0.011)	0.05
Premenopausal**	0.615 (0.020)	0.586 (0.018)	0.638 (0.020)	0.17

\*Adjusted for age, height, weight and years since menopause

\*\*Adjusted for age, height and weight

TTL = total tooth loss

differences in these two instances did not show a statistical significance.

## Discussion

Previous studies examining the association between BMD and oral hygiene have generated conflicting results. Although the highest BMD was associated with the least tooth loss and the lowest BMD with the highest tooth loss [4-7], this inverse association was not universal [10,11]. In our study, this association was seen only in the spine BMD in premenopausal women and in the trochanteric BMD in all women and women in postmenopausal age. These differences, were not statistically significant. The results of the regression analysis showed significant inverse associations for trochanteric and spine BMD, but they were not uniform in all groups. According to these results, using the total tooth loss as a surrogate marker of BMD in either lumbar spine or femoral neck cannot be justified.

An association between oral hygiene and bone health can be expected as both have common determinants. Personal habits such as smoking, alcohol consumption, calcium nutrition and HRT use are known to influence both oral hygiene and bone mineral status. There are obvious differences such as genetic composition, state of nutrition, degree of physical activities, use of HRT, degree of sun exposure, smoking habits and alcohol consumption between women in western and Asian countries and these may partly account for the differences we observed. None of the women in our sample had ever

smoked or taken alcohol, and only 2 women had taken HRT. Betel chewing is seen among Asians, and almost all subjects in our study had engaged in this habit at some stage of their life.

Previously we reported an inverse association between BMD and tooth loss in our preliminary analysis involving the first 199 women who participated in this study [12]. Data in that study, however, had not been adjusted for the number of years since menopause, which turned out to be a strong confounder of this association. When the data of the previous study were reanalysed after including the period since menopause, the differences were attenuated and did not show a statistical significance.

There were several limitations in this study. Firstly, only the total tooth loss was considered as a measure of oral hygiene. We did not measure more sensitive markers of oral hygiene such as depth of cavities. Secondly, we did not try to identify the cause of the tooth loss.

Our study did not show a uniform and strong association between total tooth loss and BMD in the spine or proximal femur, and the use of total tooth loss to detect women with high risk for osteoporosis cannot be justified.

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