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Risk factors of osteoporosis among adults in Ethiopia, the case of Tigrai region: A case control study

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Osteoporosis is one of the most common public health problems affecting adults and elderlies in developing countries. This study aims to examine the potential risk factors of osteoporosis among adults in Tigrai, Northern Ethiopia. This is a case-control study. Cases and controls were assigned by two radiologists after radiographic examination of the wrist. An interviewer administered questionnaire was used and information on demographic characteristics and potential risk factors were collected. Data was processed and analyzed using statistical package for social sciences (SPSS) version 19. Binary logistic regression was used to control confounders. A total of 130 osteoporotic cases and 266 controls participated in the study. The mean ± standard deviation (SD) age of cases and controls were 60.9 ± 10.1 and 46.9 ± 8.7 years, respectively. The multivariate analysis adjusted for age and sex showed that rural residents were 1.93 times more likely to develop osteoporosis than the urban inhabitants with an adjusted odds ratio (AOR) 1.93 (95% CI, 1.11, 3.36). The strongest association was also found when the work of the respondent involves decreased physical activity with AOR 3.53 (95% CI, 1.98 and 6.30). Furthermore, milk consumption greater than four times a week and smoking showed a significant association with the AOR 0.33 (95% CI, 0.19 and 0.58), and AOR 0.17 (95% CI, 0.05 and 0.58), respectively. Residing in the rural setting and smoking were positively associated with osteoporosis. In contrast, milk intake greater than four times a week, and when work involves vigorous exercise, appeared to be associated with a reduced risk of osteoporosis. Therefore, the findings from the study suggest the need for changes of lifestyle that includes encouraging adults to stop smoking, engage in vigorous physical activities aging and adequate dietary intake including milk. Strategies to identify and manage osteoporosis in the primary health care setting need to be established.

Key words: Case control, osteoporosis, risk factors, bone mineral density, DR-F digital radiography, Ethiopia.

INTRODUCTION

The patient profile in health institutions all over the developing world is changing. Non-communicable diseases (NCDs) have already established themselves as the predominant cause of disease and death in many middle-income countries including Ethiopia (WHO 2010).

Osteoporosis is one of the non-communicable diseases defined as a skeletal disorder characterized by low bone density and micro-architectural deterioration of bony tissue

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(Conference, 1991). It is one of the most common public health problems in adults and older people worldwide (Ross 1996). It is a common silent disease affecting both women and men over the age of 50 years. A significant number of clinical symptoms associated with osteoporosis become evident only after the occurrence of hip, vertebral, or wrist fractures. These fractures lead to many problems such as mortality, morbidity, and economic problems to individuals and the society (Bonjour 2001).

Previous studies have suggested that osteoporosis is a condition that can be prevented and treated if diagnosed early and accurately (Devine 1997). Unfortunately, it is often un-diagnosed until a fracture occurs; making the number of people who are screened for the disease very low. The correction of lifestyle factors including cigarette smoking and excessive intake of alcohol in preventing osteoporosis is a significant strategy that may be less costly when compared with medical and pharmacological interventions (Sharkey et al., 2000). Low bone mineral density in the adults can result from either low peak bone mass or accelerated bone loss, or a combination of the two. Nutritional factors play a role in both the attainment of peak bone mass and in the rate of age-related bone loss. Adequate calcium intake particularly milk and regular weight-bearing exercises are recommended for maintaining bone health and preventing excessive bone mass loss with advancing age (Eastell and Lambert 2002).

The exact prevalence of osteoporosis in developing countries is not well documented. However, according to the extrapolation of the prevalence of osteoporosis from developed countries and regions it is estimated that there are over 7.3 million cases of osteoporosis in Ethiopia (Census 2004). Despite this fact there has been a great interest in studying osteoporosis in developing countries. Currently, there has been no published study that examined the risk factors of osteoporosis in Ethiopian men and women. Hence, we undertook this study to determine the potential risk factors of osteoporosis in the Ethiopian context.

METHODOLOGY

Study design

This is a hospital based, case control study with descriptive and analytic elements.

Study setting

The study was conducted in Tigrai region, Ethiopia, with urban inhabitants making 19.5% of the population. The region is predominantly Tigrai-Tigrinya people at 96.6% of the population, and 95.6% of the population are followers of the Ethiopian Orthodox. Public zonal hospitals are 12 in number and many other health centers are providing health services to the community. Currently, there is one specialized training hospital which provides advanced services to the community where the study is conducted and the digital x-ray machine is planted (CSA 2007). The study was conducted from May, 2012 up to October, 2012 on apparently healthy men and women aged 40 and above (the recommended age strata) who visited the regional referral and training hospital for any type of care where the Digital X-ray machine is situated were the source population.

Sample size

The sample size was calculated using two proportion formula for unmatched case control design. Assuming the proportion of cases with exposure rate of 27.51% (main exposure variable age people aged 50 and above) from studies conducted elsewhere (Sharma et al., 2006) and the odds of exposure (OR = 2.15) higher than controls, with 95% confidence interval and 80% power with case to control ratio of 1 to 2, a total of 133 cases and 266 controls were required.

Sampling technique

First, all relatively healthy adult men and women aged 40 and above who came to the referral hospital outpatient department during the data collection period were purposely approached to participate in the study. Second, radiographic examination of the wrist was conducted consecutively on those who volunteered to participate until the required sample size was obtained, for cases and controls, respectively. Pregnant women, chronically debilitated patients (with any known or unknown diseases), those with known diseases that affect bone metabolism (diabetes, hypertension, cancer, kidney diseases, etc.), and severely deformed patients (Kyphosis, anomalies of the anterior arm, etc.) were excluded from the study.

Ascertainment of cases and controls

Cases were osteoporotic patients that were screened by two senior radiologists after undergoing a digital X-ray scanning onto their non-dominant wrist, while the controls were all participants without osteoporosis that were identified as osteoporosis free after undergoing the same procedure. Each X-ray result was visually inspected from the computer and read by the two radiologists independently; cases and controls were assigned when both agree. The X-ray results were discarded when they were considered to have inappropriate or poor quality by the two radiographers. X-ray results on which the radiologists did not agree were excluded from the analysis in this study. The percentage of agreement was 97.6%.

Data collection method

Data were collected using a pre-tested structured interviewer-administered World Health Organization (WHO) steps questionnaire for the identification of chronic disease risk factors (Strong and Bonita, 2002). Information on selected socio-demographic characteristics and lifestyle behaviors including physical activity, and anthropometric measurements of weight and height was obtained. Weight was measured with participants standing without shoes and wearing light clothing. Height was measured with participants standing upright and the head in the Frankfurt plane position. Height was recorded to the nearest 0.5 cm, and weight was recorded to the nearest 100 g. Body-mass index (BMI) was calculated as weight in kilograms over height in meters squared [weight (kg) / (height (m))^2]. Each participant was asked to provide information on current smoking habits and alcohol intake in average numbers of drinks per day at present. Coffee, milk intake, fruit and vegetable consumption

were obtained. Medical history including personal and family history of fracture and previous use of steroids (predinsolone) were also acquired.

In this study, excess alcohol consumption is defined as an intake of any liquor (one bottle of beer, a glass of wine, spirits, fermented cider, Tella or Tej (Local beer)) more than 2 drinks a day. Consumption of coffee greater than 2 cups (70 ml) a day was also considered as excess. Furthermore, drinking less than five glasses of milk per week (Heidi et al., 2003) and consuming fruits (orange, banana, etc.) and vegetables (Cabbage, spinach etc.) less than 5 times a week was considered as not adequate. In addition, when the work of the participant involves vigorous-intensity activity that causes large increases in breathing or heart rate like (carrying or lifting heavy loads, digging or construction work etc.) for at least 10 min continuously was considered as sufficient (WHO, 2011). The cutoff points are set after calculating the mean score of the continuous variables.

Data analysis

Data were entered and analyzed using statistical package for social sciences (SPSS) statistical software Version 19. Descriptive summary measures were used to depict levels of exposure in cases and controls. The associations between the exposure and outcome variables were determined using χ^2 statistics and backward stepwise binary logistic regression analysis to control confounders. Independent variables which have a $P < 0.3$ to the dependent variable in bivariate regression models were exported to a multiple regression model for sex and age adjustment. The major assumptions of logistic regression analysis (absence of multicollinearity and interaction among independent variables) were checked to be satisfied. The fitness of logistic regression models was assessed using the Hosmer-Lemeshow statistic and pseudo R squared values (Cox & Snell and Nagelkerke R squares). Crude odds ratios (COR) and adjusted odds ratios (AOR) along with their 95% confidence intervals (CI) were used to measure the degree of association and to test its statistical significance.

Ethical considerations

The study was conducted in line with national and international ethical recommendations to conduct biomedical research involving human subjects. Ethical clearance was secured from institutional review board of College of Health Sciences Addis Ababa University and an approval and letter of collaboration were solicited from Tigrai Regional Health Bureau. Informed written consent was taken from the study subjects after the objective of the study were briefed. Radiation safety procedures were in place. Osteoporosis related education was given to all study subjects.

RESULTS

Background information of the study subjects

A total of 396 participants- 130 osteoporosis cases and 266 healthy controls participated in the study. Among which majority 83 (63.8%) of the cases and 135 (50.8%) of the controls were females, 75 (57.7%) and 134 (50.4%) of the controls were rural dwellers. Sixty seven (51.5%) of the cases and majority (89.5%) of controls were in the age group of 40 to 50 years. Furthermore, 23 (17.7%) of the cases and 39 (14.7%) of the controls had a family history of fracture after a minor bump or fall. There was a significant difference in age and gender of the participants with the p-value of 0.001 and 0.01, respectively (Table 1).

Lifestyle characteristics of the study subjects

Among the lifestyle variables the number of current smokers was few in both the cases and the controls. Alcohol intake ≤ 2 drinks per day was observed in 87 (66.9%) of the cases and in the majority (72.2%) of the controls. In addition, this study revealed that 101 (77.7%) of the cases and 204 (76.7%) controls consume coffee ≤ 2 cups a day. It was also observed that 85 (65.4%) of the cases and 90 (33.8%) of the control drink ≤ 4 cups of milk per week. Furthermore, 86 (66.2%) and 29 (22.3%) of the cases and 194 (72.9%) and 75 (28.2%) of the controls consume fruits and vegetables ≤ 4 times a week, respectively. The mean (SD) BMI of the cases and controls was almost similar. In addition, a significant difference was found in the weight of the study participants with a p-value of 0.004 (Table 2).

Bivariate and multivariate analysis of the study subjects

The multivariate analysis adjusted for age and sex showed that rural residents were 1.93 times more likely to develop osteoporosis than the urban inhabitants with an adjusted odds ratio (AOR) 1.93 (95% CI, 1.11, 3.36). The strongest association was also found when the work of the respondent involves decreased physical activity with AOR 3.53 (95% CI, 1.98, 6.30). Furthermore, milk consumption greater than four times a week and smoking showed a significant association with the AOR 0.33 (95% CI, 0.19, 0.58), and AOR 0.17 (95% CI, 0.05, 0.58), respectively. Whereas, alcohol intake, coffee intake, fruit and vegetable consumption, steroid intake, BMI, occupation, education, monthly income, personal and family history of fractures were not associated with osteoporosis (Table 3).

DISCUSSION

We used unmatched case control study which is the first of its kind to identify risk factors of osteoporosis in the Ethiopian context. This study confirms some previously identified risk factors of osteoporosis such as consumption of milk, physical activity, current smoking status and residing in the rural. Normally we could expect that a

Table 1. Socio-demographic and fracture history related variables of the respondents by their osteoporosis status, Tigrai, Northern Ethiopia, 2012 (n=396).

Characteristics (n=396)	Osteoporosis status		P-value
	Cases n (%)	Controls n (%)	
Age	Mean (SD) =60. 9 (10.1) Median =58 IQR=15. 25	Mean (SD) =46. 9 (8.7) Median =45 IQR=10. 25	0.001
Sex			
Male	47 (36.2)	131 (49.2)	0.01
Female	83 (63.8)	135 (50.8)	
Residence			
Urban	55(42.3)	132 (49.6)	0.17
Rural	75(57.7)	134 (50.4)	
Ethnicity			
Tigrian	122 (93.8)	248 (93.2)	0.79
Non Tigrian	8 (6.2)	18 (6.8)	
Marital status			
Currently married	120 (92.3)	252 (94.7)	0.21
Never married /Separated/ Divorced	10 (7.7)	14(5.3)	
Educational status			
No formal education	44 (33.8)	70 (26.3)	0.09
Primary education	55 (42.3)	111 (41.7)	
Secondary education	17 (13.1)	50 (18.8)	
College/ University	14 (10.8)	35 (13.2)	
Occupational status			
Employed (Government, NGO, private)	99 (76.2)	181 (68)	0.001
Others (Traders, Farmers, retired)	31 (23.8)	85 (32)	
Monthly income*			
< 1000	75 (57.7)	117 (44.0)	0.14
1001-2000	29 (22.3)	81 (30.5)	
2001-3000	14 (10.8)	33 (12.4)	
>3000	12 (9.2)	35 (13.1)	
History of parents' fracture			
Yes	23 (17.7)	39 (14.7)	0.44
No	107 (82.3)	227 (85.3)	
Personal history fracture			
Yes	17 (13.1)	32 (12.0)	0.76
No	113 (86.9)	234 (88.0)	
Body Mass Index (BMI)			
≤18.5	8 (6.3)	20 (7.6)	0.66
>18.5	118 (93.7)	244 (92.4)	

*ETB = Ethiopian Birr.

Table 2. Lifestyle, anthropometric, nutrition and drug related variables of the respondents by their osteoporosis status, Tigrai, Northern Ethiopia, 2012 (n=396).

Characteristics (n=396)	Osteoporosis status	
	Cases n (%)	Controls n (%)
Smoking status (Current)		
Yes	7 (5.4)	8 (3.0)
No	123 (94.6)	258 (97.0)
Alcohol frequency		
≤2 drinks a day	87 (66.9)	192 (72.2)
>2 drinks a day	43 (33.1)	74 (27.8)
Coffee intake		
≤ 2cups a day	101 (33.1)	204 (66.9)
>2 cups a day	29 (31.9)	62 (68.1)
Milk intake		
≤ 4 Cups a week	85 (65.4)	90 (33.8)
> 4 Cups a week	45 (34.6)	176 (66.2)
Fruit intake		
≤ 4 Times a week	86 (66.2)	194 (72.9)
> 4 Times a week	44 (33.8)	72 (27.1)
Vegetable intake		
≤ 4 Times a week	29 (22.3)	75 (28.2)
> 4 Times a week	101 (77.7)	191 (71.8)
Used steroids for three months		
Yes	11 (8.5)	19 (7.1)
No	119 (91.5)	247 (92.9)
Work involves vigorous exercise		
Yes	42 (32.3)	149 (56.0)
No	88 (67.7)	117 (44.0)

sedentary lifestyle which is more common in the urban population than is in the rural contributes to the development of osteoporosis, but, in this study rural residents were 1.93 times more likely to develop osteoporosis AOR 1.93 (95% CI: 1.11, 3.37), which might be related to the high prevalence of malnutrition in rural Tigrai.

In this study, there was no significant difference between the social and demographic variables- education, monthly income, and family history of fracture and osteoporosis. This was discordant with findings in England, Turkey, Sweden, and Italy which revealed that osteoporosis was associated with poor education, family history of fracture, and low monthly income (Hui et al., 1988; Cankurtaran and Yavuz 2005; Olszynski et al., 2004; Biino et al., 2011).

Several studies in the USA reported positive associations between earlier reported milk consumption or calcium intake and BMD, but several other studies did not find this association. The milk's main selling point is calcium, and milk-drinking is touted for building strong bones in children and preventing osteoporosis in older per sons (Heidi et al., 2003; Katherine 2003; Nguyen et al., 2000). Our study indicated that milk consumption up to four times a week has a protective effect of osteoporosis with the AOR 0.33 (95% CI: 0.19, 0.57) and this result is consistent with many other studies from India, UK, Iran, and USA (Heidi et al., 2003; Nguyen et al., 2000; Ruchira et al., 2010; Lunt et al., 2001).

Evidence from the UK, USA, Australia, and India showed that exercise may help build and maintain bone density at any age. Studies have shown bone density increase by doing regular resistance exercises, such

Table 3. Multivariate analysis (final model) of the risk factors of osteoporosis among adults in Tigrai, Northern Ethiopia, December, 2012, (n= 396).

Risk factors (n=396)	COR (95%, CI)	AOR (95%, CI)
Residence		
Urban	1	1
Rural	1.34 (0.88, 2.05)	1.93 (1.11, 3.36)*
Educational status		
No formal education	1	1
Primary education	0.79(0.48,1.30)	1.62 (0.82,3.20)
Secondary education	0.54 (0.28, 1.05)	1.38 (0.57,3.31)
College/ University	0.64(0.31, 1.32)	1.24 (0.47,3.27)
Occupational status		
Employed (Government, NGO, private)	1	1
Others (Traders, Farmers, retired)	7.50 (4.56, 12.20)*	1.26 (0.64,2.50)
Monthly income*		
< 1000	1	1
1001-2000	0.56 (0.33, 0.93)*	0.94 (0.48,1.82)
2001-3000	0.66 (0.33, 1.32)	1.69 (0.73, 3.90)
>3000	0.54 (0.26, 1.09)	1.78 (0.73, 4.35)
History of parents' fracture		
Yes	1	1
No	0.79 (0.46, 1.40)	0.68 (0.34,1.36)
Personal history of fracture		
Yes	1	1
No	0.90 (0.49,1.71)	0.85 (0.39, 1.83)
Used steroids for three months		
Yes	1	1
No	0.83 (0.38, 1.81)	0.66 (0.27,1.64)
Body Mass Index (BMI)		
≤18.5	1	1
>18.5	1.21 (0.52, 2.83)	1.83 (0.65,5.21)
Smoking status (Current)		
Yes	1	1
No	0.55 (0.19, 1.54)	0.17 (0.05, 0.58)*
Alcohol frequency		
≤2 drinks a day	1	1
>2 drinks a day	1.28 (0.82,2.01)	1.47 (0.83, 2.59)
Coffee intake		
≤ 2cups a day	1	1
>2 cups a day	0.95 (0.57,1.56)	1.13 (0.60,2.11)
Milk intake		
≤ 4 Times a week	1	1

Table 3. Contd.

> 4 Times a week	0.27 (0.17, 0.42)*	0.33 (0.19, 0.58)*
Fruit intake		
≤ 4 Times a week	1	1
> 4 Times a week	1.38 (0.88, 2.17)	1.14 (0.64,2.03)
Vegetable intake		
≤ 4 Times a week	1	1
> 4 Times a week	1.37 (0.84, 2.24)	1.54 (0.82, 2.89)
Work involves vigorous intensity activity		
Yes	1	1
No	2.67 (1.72, 4.14)*	3.53 (1.98, 6.30)*

All variables adjusted for age and sex, COR= Crude odds ratio (Unadjusted odds ratio), AOR = Adjusted odds ratio, *****Significant association.

as lifting weights two or three times a week. This type of weight-bearing exercise appears to stimulate bone formation and retain calcium in the bones that are bearing the load. The force of muscles pulling against bones stimulates this bone-building process. So any exercise that places force on a bone will strengthen that bone (Jha et al., 2010; Todd and Robinson 2003; Mozaffer et al., 2008; Forwood and Larsen 2000). The result of our study also supports these evidences; when the work of the participants does not include vigorous intensive exercise they are at risk of developing osteoporosis with an adjusted odds of 3.53 (95% CI: 1.98, 6.29) compared to their counterparts.

Literatures from UK, Australia, USA and Europe also indicated that cigarette smoking is a risk factor for the development of osteoporosis; the reason is that nicotine and toxins in cigarettes affect bone health from many angles. Cigarette smoke generates huge amounts of free radicals molecules that attack and overwhelm the body's natural defenses. The result is a chain-reaction of damage throughout the body, including cells, organs, and hormones involved in keeping bones healthy (Law and Hackshaw 1997; Nguyen et al., 1994; Lunt et al., 2001; Daniel 1976; Williams et al., 2005.). Though the number of smokers is small, our study also revealed that non-smokers are 0.17 times less likely to develop osteoporosis than the smokers with the AOR 0.17 (95% CI: 0.05, 0.58).

Moderate alcohol consumption is not harmful to bone health, but heavy drinking is a health risk for many reasons, including the effects on bones. Researches from Austria and Europe showed that chronic heavy alcohol use, especially during adolescence and young adult years by interfering calcium absorption, can dramatically affect bone health and increase the risk of osteoporosis later in life (Malik et al., 2009; De Vernejoul et al., 1983). However, this study observed alcohol intake had no significant association with the development of osteoporosis; this may be attributed to the fact that many people hesitate to tell the truth about the frequency and amount of alcohol intake due to high religiosity in the study area. Furthermore, it may be due to lack of statistical power of the study.

A study in USA implied that caffeine increases urinary calcium output and has been implicated as a risk factor for osteoporosis that leads to hip fracture (Douglas 1990), while some other researches in Sri Lanka, California, and Minnesota indicate that the effect of caffeine on bone mineral density is because of the interaction between cigarette and alcohol abuse (Glynn et al., 1995; Heaney 2002; Cooper et al., 1992). This study however revealed no significant association between caffeine intake and osteoporosis. Studies from the USA and Korea confirm that a high BMI (above 30 kg/m^2) has a protective effect for both men and women, in contrast low BMI less than 19 kg/m^2 can lead to osteoporosis (Wardlaw 1996; Barrera et al., 2004; Kenny et al., 2000; Shin et al., 2004). While our study failed to show the association between BMI and osteoporosis. A similar reason can be given that the difference in mean body weight and mean height of the cases and the controls was almost similar.

A study in the USA has linked higher intakes of fruits and vegetables with better bone health. Though it is not clear why fruits and vegetables promote healthy bones, many scientists believe that fruits and vegetables contain certain nutrients such as calcium, magnesium, potassium, vitamin C, vitamin K or a combination of these vitamins that are beneficial for bones. Some studies

indicate that the higher fruit intake was found to be significantly associated with higher BMD in both sexes. High vegetable consumption, however, did not positively impact BMD Zalloua et al., 2007. Further UK and USA studies also indicate consumption of more fresh fruits and vegetables is unlikely to be detrimental to bone health and may be beneficial (Prentice 2004; Vatanparast et al., 2005). However, the current study did not show an association between fruit and vegetable consumption and osteoporosis, under reporting of dietary intake by the participants might explain why this difference was not apparent in the study.

Corticosteroids have several adverse effects on bone metabolism. Direct inhibition of osteoblast function, direct enhancement of bone resorption, inhibition of gastrointestinal calcium absorption, increase in urinary calcium loss, and inhibition of gonadal hormones mainly affect the trabecular bone. In our study, corticosteroid intake did not show a significant association, this could be because of the problem of reporting the exact type of medication (Walsh et al., 2002; Sinigaglia et al., 2000; IP et al., 1994) Studies from UK and USA confirmed that family and personal history of osteoporosis or osteoporotic fracture is a risk factor for osteoporosis (Kanis et al., 2004; Ralston and de Crombrugghe, 2006), while our study found a lack of association between family and personal history of fracture among the cases and controls. The reason for the lack of association is not clear.

LIMITATIONS OF THE STUDY

Though the study is the first of its kind in the region the results have to be interpreted within the context of potential limitations. First, the population is composed of volunteers not randomly selected who do not ensure representation of the general population; therefore, this may introduce selection bias. Second, because we excluded individuals with diseases deemed to interfere with bone metabolism, the risk factors of osteoporosis reported here could be an underestimate of the risk factors in the general population. Third, we have used mean scores for milk and fruit and vegetable consumption for comparison with other literatures; this should have to be interpreted cautiously. Fourth, we did not use the gold standard diagnostic DEXA to assign cases and controls that might lead to inflate the false negative rate. However, this research did not intend to establish the prevalence of osteoporosis but to identify associations with low bone mass (osteoporosis). On the other hand, our study is the first to report risk factors of osteoporosis in men and women in Ethiopia, while many of the published studies in the literature come from American, European and Asian countries.

Conclusion

Residing in the rural setting and smoking was positively associated with osteoporosis. In contrast, milk intake greater than four times a week, and when work involves vigorous exercise appeared to be associated with a reduced risk of osteoporosis. Therefore, the findings from the study suggest the need for changes of lifestyle that includes encouraging adults to stop smoking, engage in vigorous physical activities for active aging and adequate dietary intake including milk. Strategies to identify and manage osteoporosis in the primary health care setting to reach the rural people need to be established. Large community-based studies using the gold standard bone density scanner for a better knowledge of the risk factors of osteoporosis for early prevention and treatment is needed.

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REFERENCES

Barrera G, Bunout D, Gattás V, de la Maza MP, Leiva L, Hirsch S (2004). A high body mass index protects against femoral neck osteoporosis in healthy elderly subjects. Nutrition 20(9):769-771.

Biino G, Casula L, de Terlizzi F, Adamo M, Vaccargiu S, Francavilla M, Loi D, Casti A, Atzori M, Pirastu M (2011). Epidemiology of osteoporosis in an isolated Sardinian population by using quantitative ultrasound.". Am. J. Epidemiol. 174 (4):432-9.

Bonjour JP, Chevalley T, Ammann P, Slosman D, Rizzoli R (2001). Gain in bone mineral mass in prepubertal girls 3.5 years after discontinuation of calcium supplementation: A follow-up study. Lancet. 358:1208-1212.

Cankurtaran M, Yavuz B B (2005). General characteristics, clinical features and related factors of osteoporosis in a group of elderly Turkish men." Aging Clin. Exp. Res. 17(2):108-15.

Census Bureau US (2004). Statistics by Country for Osteoporosis. International Data Base.

Conference, CD (1991). Diagnosis, prophylaxis and treatment of Osteoporosis. . Am. J. Med. 90: p. 107-10.

Cooper C, Atkinson EJ, Wahner HW, O'Fallon WM, Riggs BL, Judd HL, Melton LJ 3rd (1992). Is caffeine consumption a risk factor for osteoporosis? J. Bone Miner Res. 7(4):465-71.

CSA (2006). The Census by the Central Statistical Agency of Ethiopia. 2007.

Daniel HW (1976) Osteoporosis of the Slender SmokerVertebral Compression Fractures and Loss of Metacarpal Cortex in Relation to Postmenopausal Cigarette Smoking and Lack of Obesity. Arch. Intern. Med. 136(3):298-304.

de Vernejoul MC, Bielakoff J, Herve M, Gueris J, Hott M, Modrowski D, Kuntz D, Miravet L, Ryckewaert A (1983). Evidence for defective osteoblastic function. A role of alcohol and tobacco consumption in osteoporosis in middle-aged men. Clin. Orthop. Relat. Res. 179:107-115.

Devine A, Dick IM, Heal SJ, Criddle RA, Prince RL (1997). A 4-year follow-up study of the effects of calcium supplementation on bone density in elderly postmenopausal women. Osteoporos. Int. 7:23-28.

Eastell R, Lambert H (2002).Strategies for skeletal health in the elderly. Proc. Nutr. Soc. 61(2):173-80.
Forwood MR, Larsen JA (2000). Exercise recommendations for osteoporosis 'A position statement of the Australian and New Zealand Bone and Mineral Society. Aust. Family Physician 29(8):761-764.
Glynn NW, Meilahn EN, Charron M, Anderson SJ, Kuller LH, Cauley JA (1995). Determinants of bone mineral density in older men. J. Bone Miner. Res. 10(11):1769-77
Heaney RP (2002). Effects of caffeine on bone and the calcium economy. Food Chem. Toxicol. 40(9):1263-1270.
Hingorjo MR, Syed S, Qureshi MA (2008). Role of exercise in osteoporosis prevention - Current concepts. J. Pak. Med. Assoc. 58(2): 78-81.
Hui SL, Slemenda CW, Johnston CC (1988). Age and bone mass as predictors of fracture in a prospective study. J. Clin. Invest. 81 (6):1804-1809.
Ip M, Lam K, Yam L, Kung A, Ng M (1994).Decreased bone mineral density in premenopausal asthma patients receiving long-term inhaled steroids. Chest 105(6):1722-1727.
Kalkwarf HJ, Khoury JC, Lanphear BP (2003). Milk intake during childhood and adolescence, adult bone density, and osteoporotic fractures in US women. Am. J. Clin. Nutr. 77(1):65.
Kanis JA, Johansson H, Oden A, Johnell O, De Laet C, Eisman JA, McCloskey EV, Mellstrom D, Melton LJ 3rd, Pols HA, Reeve J, Silman AJ, Tenenhouse A (2004). A family history of fracture and fracture risk: a meta-analysis. Bone 35(5):1029-37.
Katherine LT (2003). Does milk intake in childhood protect against later osteoporosis? Am. J. Clin. Nutr. 77: p. 10-1.
Kenny AM, Prestwood KM, Marcello KM, Raisz LG (2000)."Determinants of bone density in healthy older men with low testosterone levels." J. Gerontol. A Biol. Sci. Med. Sci. 55(9):492-7
Kiel DP, Felson DT, Hannan MT, Anderson JJ, Wilson PW (1990). Caffeine and the risk of hip fracture: the Framingham study. Am. J. Epidemiol. 132(4):675-684.
Law MR, Hackshaw AK (1997). A meta-analysis of cigarette smoking, bone mineral density and risk of hip fracture: recognition of a major effect. BMJ 315:841-6.
Lunt M, Masaryk P, Scheidt-Nave C, Nijs J, Poor G, Pols H, Falch JA, Hammermeister G, Reid DM, Benevolenskaya L, Weber K, Cannata J, O'Neill TW, Felsenberg D, Silman AJ, Reeve J (2001). The effects of lifestyle, dietary dairy intake and diabetes on bone density and vertebral deformity prevalence: the EVOS study. Osteoporos. Int. 12 (8):688-98.
Lunt M, Masaryk P, Scheidt-Nave C, Nijs J, Poor G, Pols H, Falch JA, Hammermeister G, Reid DM, Benevolenskaya L, Weber K, Cannata J, O'Neill TW, Felsenberg D, Silman AJ, Reeve J (2001).The effects of lifestyle, dietary dairy intake and diabetes on bone density and vertebral deformity prevalence: the EVOS study.". Osteoporos. Int. 12(8):688-98.
Malik P, Gasser RW, Kemmler G, Moncayo R, Finkenstedt G, Kurz M, Fleischhacker WW (2009). Low bone mineral density and impaired bone metabolism in young alcoholic patients without liver cirrhosis: a cross-sectional study. Alcohol. Clin. Exp. Res. 33(2):375-81.
Nguyen TV, Center JR, Eisman JA (2000). Osteoporosis in elderly men and women: effects of dietary calcium, physical activity, and body mass index. J. Bone Miner Res. 15(2):322-31.
Nguyen TV, Kelly PJ, Sambrook PN, Gilbert C, Pocock NA, Eisman JA (1994). Lifestyle factors and bone density in the elderly: Implications for osteoporosis prevention. J. Bone Miner. Res. 9(9):1339-1346.
Olszynski WP, Shawn Davison K, Adachi JD, Brown JP, Cummings SR, Hanley DA, Harris SP, Hodsman AB, Kendler D, McClung MR, Miller PD, Yuen CK (2004). Osteoporosis in men: epidemiology, diagnosis, prevention, and treatment. Clin. Ther. 26(1):15-28.
Prentice A (2004). Diet, Nutrition and the prevention of osteoporosis; MRC Human Nutrition Research, Elsie Widdowson Laboratory, Cambridge, UK. Public Health Nutr. 7(1A):227-243.
Ralston SH, de Crombrugghe B (2006). Genetic regulation of bone mass and susceptibility to osteoporosis. Genes Dev. 20(18):2492-2506.
Ross PD (1996). Prediction of fracture risk. II: Other risk factors. Am. J. Med. Sci. 312(6):260-269.
Ruchira MJ, Ambrish M, Nidhi M, Edward MB (2010). Pilot case-control investigation of risk factors for hip fractures in the urban Indian population". BMC Musculoskelet Disord. 11: p. 49.
Sharkey N A, Willian NL, Guerin JB (2000). The role of exercise in the prevention and treatment of osteoporosis and osteoarthritis. Nurs. Clin. North Am. 35(1):209-21.
Sharma S, Tandon VR, Mahajan A, Kour A, Kumar D (2006) Primary screening of osteoporosis and osteopnea in urban women from Jammu using calcaneal QUS. Ind. J. Med. Sci. 60(5):183-189.
Shin A, Choi JY, Chung HW, Park SK, Shin CS, Choi YH, Cho SI, Kim DS, Kim DI, Lee KM, Lee KH, Yoo KY, Kang D (2004). "Prevalence and risk factors of the distal radius and calcaneus bone mineral density in Korean population." Osteoporos. Int. 15(8):639-44.
Sinigaglia L, Nervetti A, Mela Q, Bianchi G, Del Puente A, Di Munno O, Frediani B, Cantatore F, Pellerito R, Bartolone S, La Montagna G, Adami S (2000). A multicenter cross sectional study on bone mineral density in rheumatoid arthritis. Italian Study Group on Bone Mass in Rheumatoid Arthritis. J. Rheumatol. 27(11):2582-2589.
Strong K, Bonita R (2003). The SuRF Report 1. Surveillance of Risk Factors related to Noncommunicable Diseases: Current status of global data. Geneva: World Health Organization.
Todd JA, Robinson RJ (2003). Osteoporosis and exercise. Postgrad Med. J. 79(932):320-323.
Vatanparast H, Baxter-Jones A, Faulkner RA, Bailey DA, Whiting SJ (2005) Positive effects of vegetable and fruit consumption and calcium intake on bone mineral accrual in boys during growth from childhood to adolescence the University of Saskatchewan, Pediatric Bone Mineral Accrual Study. Am. J. Clin. Nutr. 82(3):700 - 6.
Walsh LJ, Lewis SA, Wong CA, Cooper S, Oborne J, Cawte SA, Harrison T, Green DJ, Pringle M, Hubbard R, Tattersfield AE (2002). The Impact of Oral Corticosteroid Use on Bone Mineral Density and Vertebral Fracture. Am. J. Respir. Crit. Care Med. 166(5):691-5.
Wardlaw GM (1996). Putting body weight and osteoporosis into perspective.Am. Clin. Nutr. 63: p. 433S-6S.
WHO (2010). Package of essential non-communicable diseases (PEN) interventions for primary health care in low-resource settings'. World Health Organization Report, Geneva.
WHO (2011). The WHO STEPwise approach to noncommunicable disease risk factor surveillance (STEPS).
Williams F, Cherkas L, Spector T, MacGregor A (2005). The effect of moderate alcohol consumption on bone mineral density: a study of female twins. Ann. Rheum Dis. 64: p. 309-310.
Zalloua PA, Hsu YH, Terwedow H, Zang T, Wu D, Tang G, Li Z, Hong X, Azar ST, Wang B, Bouxsein ML, Brain J, Cummings SR, Rosen CJ, Xu X (2007). Impact of seafood and fruit consumption on bone mineral density." Maturitas 56(1):1-11.