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SOCIOECONOMIC CHARACTERISTICS AND LIFESTYLE ELEMENTS VS. 10-YEAR FRACTURE RISK IN PEOPLE AGED 65+ FROM SMALL TOWNS IN THE NORTH-EAST OF POLAND. THE SENFOOD PROJECT

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ABSTRACT

Introduction. This study evaluated the correlation between selected socioeconomic and lifestyle characteristics and 10-year risk of fracture in persons aged 65+, living in small towns in the north-east of Poland.
Material and methods. 267 individuals (76 males and 191 females) aged 76.9 ±2.5 years, living in small towns in the north-east of Poland in independent households, took part in the study. The basic information on the socioeconomic situation and lifestyle of the subjects was gathered during a face-to-face interview. Dual energy X-ray absorptiometry (DXA) was used to determine bone mineral density (BMD) in the distal part of the forearm. The absolute 10-year risk of bone fracture was calculated in accordance with the algorithm developed by WHO and IOF [Kanis et al. 2005].
Results. The average value of 10-year fracture risk was significantly higher in females than in males (31.4% vs. 14.5%, respectively), as was the probability of fracturing a thigh bone (13.7% vs. 6.1%, respectively), as was the probability of any fracture (23.9% vs. 10.1%, respectively), but BMD was lower (290.6 mg/cm^2 vs. 405.2 mg/cm^2, respectively). A higher 10-year risk of fracture was observed in people who used dietary supplements (T3 RB-10: OR = 3.23; 95% CI: 1.61-6.47) and a lower risk was observed in people who had a spouse/partner (T3 RB-10: OR = 0.14; 95% CI: 0.07-0.28), lived with someone (T3 RB-10: OR = 0.20; 95% CI: 0.08-0.48) and with a high physical activity (T2 RB-10: OR = 0.68; 95% CI: 0.47-0.99).
Conclusions. The 10-year risk of fracture was significantly gender-related. Lower bone mineral density and more than twice higher 10-year fracture risk, probability of fracturing a thigh bone and any fracture was observed in women than in men. The 10-year risk of fracture was higher in single persons, living alone, with a low physical activity and using dietary supplements.

Key words: 10-year fracture risk, bone mineral density, the elderly, lifestyle, socioeconomic characteristics

INTRODUCTION

Osteoporosis is defined as the condition of the bone system in which the intensity of demineralisation processes is higher than that of bone formation [WHO 1994]. When that is the case, adverse changes in bone microstructure take place and bones become porous, which leads to skeleton deformation. A decrease in the bone mineral density (BMD) reduces their mechanical strength, which makes them more susceptible to fracture, even as a result of a minor injury [Kanis et al. 2005]. A first fracture increases the risk of subsequent

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fractures in the nearest perspective [Mitani et al. 2010]. Most cases of fractures caused by osteoporosis take place in the femoral neck, distal end of the forearm and proximal humerus. Fracture of the femoral neck is one of the most serious consequences of osteoporosis as it leads to lowering the quality of life as a result of difficulties in doing one's daily routine activities [Muraki et al. 2007].

Osteoporosis is one of the major public health issues around the world [WHO 1994]. It has been estimated that the number of femoral neck fractures around the world will increase from the present 4 million to over 6 million [Kanis et al. 2002]. According to epidemiological data, Poland is one of the countries with the lowest risk of femoral neck fracture in Europe [Czerwinski et al. 2009]. The incidence of osteoporosis and fracture rate are much higher in elderly people than the young and higher in women than in men [Czerwinski et al. 2009, Cawthon 2011, Lippuner et al. 2009]. It has been shown that 2/3 of all osteoporotic fractures are suffered by women [Scholtissen et al. 2009]. The number of hip fractures in Poland per 100,000 cases in people in the 6^{th}, 7^{th} and 8^{th} decade of life in 2005 was equal to 67; 244 and 876, respectively, in the female population, and 71; 162 and 502 in the male population [Czerwinski et al. 2009]. Canadian research has shown that osteoporotic fractures take place more often in residents of small towns than in those of rural areas or big cities, however this relationship was not explained [Vanasse et al. 2010].

Intensity of osteoporosis is seen to increase with age, hence an increase in the average life expectancy has caused the number of osteoporotic fractures to increase [Mitani et al. 2010, Cauley et al. 2005]. Gradual depletion of bone tissue with age (approx. 5-10% during 10 years) is caused, among other factors, by weakened activity of osteoblasts as a result of hormone system disorders and decreased calcium absorption from the gastrointestinal tract [Cauley et al. 2005]. A decrease in BMD in peri- and post-menopausal women is a result of a decrease in the oestrogen level [Scholtissen et al. 2009]. The mineral bone density is a strong predictor of fractures [Sigurdsson et al. 2006]. However, determination of BMD is not sufficient to evaluate the risk of an osteoporotic fracture because the etiology of osteoporosis is multi-factorial. Therefore, it is necessary to take into account many independent non-bone factors which affect the metabolism of bone tissue. Apart from genetic and nutritional factors, these include: decreased physical activity as a result of reduced muscular strength and insufficient mobility in elderly people, the presence of chronic diseases, smoking and alcohol abuse [Cauley et al. 2005, Robbins et al. 2007]. Currently, there is not enough literature data on socioeconomic characteristics such as a marital status or lives (alone or with someone), level of education or economic situation on the bone condition in elderly people. The risk of an osteoporotic fracture within the next 10 years can be expressed as the absolute 10-year fracture risk (RB-10). An assessment of RB-10 takes into account the age and gender of the person under assessment, the result of a densitometric determination and the presence of non-bone factors, determining the risk of fracture for a specific site, usually the femoral neck [Dawson-Hughes et al. 2008]. The risk increases from the age of 65 years to 75 years in men and to 80 years in women and decreases in the subsequent decades of life [Dawson-Hughes et al. 2008]. The absolute 10-year fracture risk also plays an important role in taking decisions on a therapeutic intervention [Czerwinski et al. 2009]. Diagnosing osteoporosis only based on the T-score BMD < -2.5 cannot mean that therapy is necessary. It has been shown many times that a considerable percentage of osteoporotic fractures are observed in patients for whom the result of a densitometric determination does not indicate any risk of osteoporosis [Clark et al. 2012].

The aim of this study was to evaluate the relationship between selected socioeconomic and lifestyle characteristics and 10-year risk of fracture in persons aged 65+, living in small towns in the north-east of Poland.

MATERIAL AND METHODS

The sample and its characteristics

The study was conducted in 2010-2011 as part of the SENFOOD project. The study sample was taken by the snowball method. The following inclusion criteria were adopted: the north-east of Poland, environment: small towns with a population of ≤50 thousand inhabitants, type of household: free-living (independent), age: 65+ years, and gender: men and women. Nutritional, anthropometric, biochemical and densitometric

examinations were carried out among 1,437 people (total sample), including 452 men and 985 women aged 77.2 ±2.1 (67.1-85.7) years. Complete data on the osteoporosis risk factors were obtained for 267 subjects (sub-sample), including 76 men aged 76.8 ±2.3 (71.0-82.1) years and 191 women aged 77.0 ±2.6 (67.1-85.1) years. The subjects from the total sample and in the sub-sample (with information on osteoporosis risk factors) did not differ in socioeconomic and somatic parameters (Table 1). Each of the subjects

Table 1. Socioeconomic characteristics, BMI and WHtR of the total sample and sub-sample (with osteoporosis risk factors)

Parameter	Sample percentage, %		p
	total sample	sub-sample	
Marital status	(1437)	(267)	
– married/with partner	52	51	NS
– lonely	48	49	
Lives	(1402)	(261)*	
– alone	25	27	NS
– with someone	75	73	
Level of education	(1437)	(267)	
– basic	50	48	NS
– medium	43	43	
– higher	7	9	
The economic situation	(1437)	(267)	
– good	24	21	NS
– average	63	67	
– poor	11	10	
State of health	(1437)	(267)	
– good/very good	23	19	NS
– average	57	62	
– bad/very bad	20	18	
BMI, kg/m^2	(1401)	(267)	
X ±SD	28.1 ±4.6	29.1 ±5.0	NS
Min-Max	13.7-47.2	13.7-46.9	
WHtR	(1104)	(267)	
X ±SD	0.61 ±0.08	0.62 ±0.08	NS
Min-Max	0.39-0.89	0.39-0.89	

*No data for 6 people.
X – arithmetic average. SD – standard deviation. Min-Max – minimum and maximum value. p – level of significance. NS – insignificant differences. ( ) – sample size.

gave their informed consent to participate in the study. The research got a permission from the Bioethics Committee of the Faculty of Medical Sciences, University of Warmia and Mazury in Olsztyn on June 17. 2010, Resolution No. 20/2010.

The presence of independent risk factors for fracture

The basic information on the socioeconomic situation and lifestyle of the subjects was gathered during individual face-to-face interviews, conducted with the use of multiple choice questionnaires. All subjects were asked about their marital status, education, financial situation, physical activities, taking vitamin and/or mineral supplements within the past 12 months, self-evaluation of the health status and any chronic diseases. The questionnaire also contained questions about any independent risk factors for fracture according to the WHO criteria [Kanis et al. 2005], which included the history of fractures resulting from a minor injury after the age of 50, a hip fracture in one or both parents, taking glucocorticosteroid drugs, diagnosed rheumatoid arthritis, smoking, alcohol abuse (consuming at least 0.5 l of beer/300 ml of wine/60 ml of vodka/day).

Densitometry

Bone mineral content (BMC) and bone mineral density (BMD) were determined in 175 subjects, including 46 men aged 76.7 ±2.1 (73.7-82.1) years and 129 women aged 77.0 ±2.6 (69.7-85.1) years, by dual energy X-ray absorptiometry (DXA) with a pDEXA densitometer, manufactured by Norland STRATEC Medical Systems. The determination covered the distal forearm. Determinations were conducted in a field study, in the subjects' homes or at designated sites near them. The BMD values were expressed with the number of standard deviations from the mean BMD value, fitted to the age, sex and ethnic group (Caucasian race) of a same-age person (Z-score) and the number of standard deviations from the mean BMD value for a population with the peak bone mass in the same ethnic group (T-score).

Absolute 10-year fracture risk

According to the guidelines developed by WHO and the International Osteoporosis Association [Kanis et al. 2005], an assessment of the absolute 10-year fracture risk (RB-10) was made as follows:

$$RB\text{-}10 = RP\text{-}10 \times RW_{BMI} \times RW_{factors}, \%$$

where:

RP-10 – mean 10-year population risk of fracture of the proximal femur, according to gender and age,

RW_{BMI} – relative risk of proximal femur fracture depending on the BMI value,

$RW_{factors}$ – the product of the relative risk of risk factors for fracture.

For each of the subjects, 10-year probability of the proximal femoral fracture ($RB\text{-}10_{pf}$) was determined as well as 10-year probability of any fracture ($RB\text{-}10_{af}$), taking into account the product of the relative risk, the subject's gender and age [Kanis et al. 2005].

The values of T-score BMD obtained in the study were interpreted based on the corresponding ranges of standard deviations, as per the following pattern:

- T-score BMD ≥ –1 – correct bone mineral density
- –2.5 ≤ T-score BMD < –1 – low bone mineral density (osteopenia)
- T-score BMD < –2.5 – very low bone mineral density (osteoporosis) [WHO 1994].

The values of the main parameters of bone mineral density, risk and fracture probability were compared among the male and female subjects. Tertiles ranges of RB-10 for the sub-sample were determined in a later part of the analyses, where the following values were adopted as the cut-off points:

T1 RB-10 < 11.7%

11.7% ≤ T2 RB-10 ≤ 24.2%

T3 RB-10 > 24.2%.

Similarly, tertile groups for BMD were determined:

T1 BMD < 267.7 mg/cm^2

267.7 mg/cm^2 ≤ T2 BMD ≤ 347.2 mg/cm^2

T3 BMD > 347.2 mg/cm^2.

In the analysis of fracture risk has not been studied RB-10 separately for gender and age groups of respondents, because they are included in the algorithm for calculating the RB-10 and because of the small sample size.

Statistical analysis

Continuous variables were expressed as arithmetic averages (X), standard deviation (SD), as well as the range: minimum (min) and maximum (max)

value. The population size and sample percentage (%) were determined for the categorised variables. The analysis of variance of the quantitative variables was performed, while a non-parametric test Chi^2 was performed for categorised variables. Six independent variables, confirmed to be differentiated in relation to RB-10: marital status (married/with partner or single; $p < 0.001$), lives (with someone or alone; $p < 0.001$), the level of physical activity (large or small; $p < 0.05$), supplementation (yes or no; $p < 0.01$), state of health (good/very good or bad/very bad; $p < 0.05$) and alcohol abuse (yes or no; $p < 0.05$), were included in the logistic regression analysis. The odds ratio (OR) and 95% confidentiality interval (95% CI) were determined for them in relation to tertile groups RB-10, where T1 RB-10 was adopted as the reference group. A statistical analysis of the results was performed by the Statistica 10.V.PL program at the level of significance of $p < 0.05$.

RESULTS

The male subjects had considerably higher BMC and BMD than female subjects: 1916.2 mg and 1206.8 mg ($p < 0.001$) and 405.2 mg/cm^2 and 290.6 mg/cm^2 ($p < 0.001$; Table 2), respectively. The male subjects had twice as high T-score BMD than the female subjects (–0.6 vs. –1.2; $p < 0.05$). The high values of the standard deviation and broad minimum-maximum range of the parameters could indicate large differentiation of the bone condition in the subjects. The average value of RB-10, $RB\text{-}10_{pf}$ and $RB\text{-}10_{af}$ was more than twice higher in the female subjects than in the males: 31.4% vs. 14.5%, 13.7% vs. 6.1% and 23.9% vs. 10.1% ($p < 0.001$; Table 2). Women had a significantly higher mean RP-10 and $RW_{factors}$ than men, respectively 11.7 vs. 5.9 ($p < 0.001$) and 2.2 vs. 1.9 ($p < 0.05$). The average value of RW_{BMI} was similar in both sexes and was 1.2 (results not posted). Selected socioeconomic and lifestyle characteristics for female and male subjects included in Table 3.

With the increase in the RB-10 bone mineral density of subjects decreased. The average value of BMD was 409.2 mg/cm^2 for the lower tertile RB-10, 313.0 mg/cm^2 for the middle tertile RB-10 and 278.1 mg/cm^2 for the upper tertile RB-10 ($p < 0.001$, Table 4). The average value of BMD Z-score was significantly lower in the upper tertile RB-10 than in the middle tertile RB-10 (0.08 vs. 0.88, $p < 0.01$), respectively. Similarly, the average value of the T-score BMD was significantly lower for the upper tertile RB-10 as compared to the lower and middle tertile RB-10 (–1.60 vs. –0.39 and –0.89, $p < 0.001$), respectively. The percentage of subjects with the correct bone mass (T-score BMD ≥ -1) decreased with increasing RB-10, and was equal to: 59% for the lower tertile, 51% for the middle tertile and 30% for the upper tertile of RB-10 ($p < 0.001$, Table 4). Conversely, the portion of subjects with very low bone mass (T-score BMD < -2.5) increased with increasing RB-10 and was equal to 3% for the lower tertile, 5% for the middle tertile and 30% for the upper tertile of RB-10 ($p < 0.001$).

Among the 10 discussed socioeconomic and lifestyle characteristics, statistically significant relationships with 10-year fracture risk have been confirmed for 6 of them: marital status ($p < 0.001$), lives ($p < 0.001$), the level of physical activity ($p < 0.05$), supplementation ($p < 0.01$), state of health ($p < 0.05$) and alcohol abuse ($p < 0.05$, Table 5). In the lower tertile of RB-10 were the largest number of the subjects, in the (married/with partner) category (77%), lives with someone (89%) and not taking supplementation (73%). In the upper tertile of RB-10, were the largest number of single people (69%), with a low physical activity (42%) and taking supplementation (54%). In the upper tertile of RB-10, as compared with the lower tertile of RB-10, alcohol abuse was significantly more frequent (15% vs. 0%, $p < 0.05$) the percentage of single people was higher (69% vs. 23%, $p < 0.001$), living alone (39% vs. 11%, $p = 0.001$) and taking supplementation (54% vs. 27%, $p < 0.01$), whereas the percentage of subjects who see their health as good or very good was significantly lower (12% vs. 25%, $p < 0.05$). There were significantly more subjects with a low physical activity level in the upper tertile of RB-10 as compared to the middle tertile (42% vs. 26%, $p < 0.05$).

In the logistic regression analysis, the relationship of RB-10 with four out of the six analysed characteristics was confirmed (Table 6). The probability of high RB-10 was significantly lower in people who have a spouse or a partner (T2: OR = 0.35, 95% CI: 0.18-0.71 and T3: OR = 0.14, 95% CI: 0.07-0.28), living with someone (T2: OR = 0.34, 95% CI: 0.14-0.83

Table 2. Age, bone mineral density and risk and probability of osteoporotic fractures in female and male subjects

Parameter	Sub-sample	Men	Women	p
Age, years	(267)	(76)	(191)	NS
X ±SD	76.9 ±2.5	76.8 ±2.3	77.0 ±2.6	
Min-Max	67.1-85.1	71.0-82.1	67.1-85.1	
BMC, mg	(175)	(46)	(129)	< 0.001
X ±SD	1 561.5 ±513.5	1 916.2 ±516.3	1 206.8 ±362.6	
Min-Max	608.7-3271.0	810.5-3271.0	608.7-2378.0	
BMD, mg·cm^{-2}	(175)	(46)	(129)	< 0.001
X ±SD	347.9 ±94.4	405.2 ±102.4	290.6 ±70.4	
Min-Max	156.8-708.0	214.2-708.0	156.8-527.0	
Z-score BMD	(172)*	(46)	(126)	NS
X ±SD	0.4 ±1.5	0.2 ±1.5	0.6 ±1.5	
Min-Max	–2.5-5.7	–2.5-4.6	–2.2-5.7	
T-score BMD	(175)	(46)	(129)	< 0.05
X ±SD	–0.9 ±1.4	–0.6 ±1.5	–1.2 ±1.4	
Min-Max	–3.9-3.8	–3.5-3.8	–3.9-3.5	
T-score BMD, % of sample	(175)	(46)	(129)	NS
T-score BMD ≥ –1	48	54	42	
–2.5 ≤ T-score BMD < –1	40	37	43	
T-score BMD < –2.5	12	9	15	
RB-10, %	(267)	(76)	(191)	< 0.001
X ±SD	26.6 ±24.5	14.5 ±13.7	31.4 ±26.1	
Min-Max	0.0-200.6	0.0-71.3	3.9-200.6	
RB-10$_{pf}$, %	(267)	(76)	(191)	< 0.001
X ±SD	9.9 ±8.6	6.1 ±4.8	13.7 ±8.8	
Min-Max	2.4-51.6	3.7-31.8	2.4-51.6	
RB-10$_{af}$, %	(267)	(76)	(191)	< 0.001
X ±SD	17.0 ±12.3	10.1 ±5.9	23.9 ±12.0	
Min-Max	7.0-58.1	7.0-39.3	9.6-58.1	

*No data for 3 people.
X – arithmetic average. SD – standard deviation. Min-Max – minimum and maximum value. BMC – bone mineral content. BMD – bone mineral density. T-score BMD – standard deviation from mean BMD for population with the peak bone mass. Z-score BMD – standard deviation from the mean value of BMD of a same-age person. RB-10 – absolute 10-year fracture risk. RB-10$_{pf}$ – 10-year probability of proximal femoral fracture. RB-10$_{af}$ – 10-year risk of any fracture. p – level of significance. NS – insignificant differences. ( ) – sample size.

Table 3. Selected socioeconomic and lifestyle characteristics for female and male subjects, % of the sub-sample

Parameter	Sub-sample	Men	Women	p
Marital status	(267)	(76)	(191)	< 0.001
– married/with partner	51	86	38	
– lonely	49	14	62	
Lives	(261)*	(76)	(185)	< 0.001
– alone	27	9	34	
– with someone	73	91	66	
Level of education	(267)	(76)	(191)	NS
– basic	48	47	48	
– medium	43	45	42	
– higher	9	8	10	
The economic situation	(267)	(76)	(191)	NS
– good	21	20	22	
– average	68	70	66	
– poor	11	10	12	
The level of physical activity	(267)	(76)	(191)	NS
– small	32	31	33	
– moderate	39	32	41	
– large	29	37	26	
Supplementation	(267)	(76)	(191)	< 0.01
YES	41	26	47	
State of health	(267)	(76)	(191)	NS
– good/very good	20	25	17	
– average	62	59	63	
– bad/very bad	18	16	20	
Chronic diseases	(267)	(76)	(191)	< 0.01
YES	88	80	92	
Current smoking	(267)	(76)	(191)	< 0.001
YES	8	20	4	
Alcohol abuse	(108)**	(29)	(79)	< 0.01
YES	3	4	2	

*No data for 6 people.
**No data for 159 people.
p – level of significance. ( ) – population size.

Table 4. Bone density distribution vs. absolute 10-year fracture risk, % of the sub-sample

Parameter	Sub-sample	Terciles RB-10			p
		T1	T2	T3	
BMD, mg·cm^{-2}	(175)	(37)	(75)	(63)	< 0.001
X ±SD	320.8 ±94.4	409.2 ±102.8^{ab}	313.0 ±72.5^{ac}	278.1 ±77.4^{bc}	
Min-Max	156.8-708.0	219.7-708.0	156.8-527.0	170.2-542.3	
Z-score BMD	(172)*	(37)	(73)	(62)	< 0.01
X ±SD	0.53 ±1.50	0.61 ±1.48	0.88 ±1.47^{c}	0.08 ±1.46^{c}	
Min-Max	–2.49-5.67	–1.58-4.63	–2.24-5.67	–2.49-4.86	
T-score BMD	(175)	(37)	(75)	(63)	< 0.001
X ±SD	–1.04 ±1.44	–0.39 ±1.45^{b}	–0.89 ±1.35^{c}	–1.60 ±1.35^{bc}	
Min-Max	–3.85-3.83	–2.6-3.83	–3.85-3.53	–3.85-2.71	
T-score BMD, % of sample	(175)	(37)	(75)	(63)	< 0.001
T-score BMD ≥ –1	45	59^{b}	51^{c}	30^{bc}	
–2.5 ≤ T-score BMD < –1	41	38	44	40	
T-score BMD < –2.5	14	3^{b}	5^{c}	30^{bc}	

*No data for 3 people.
RB-10 – absolute 10-year fracture risk. T1, T2, T3 – tertile intervals. BMD – bone mineral density. T-score BMD – standard deviation from the average BMD of the population with peak bone mass. Z-score BMD – standard deviation from the mean value of BMD of a same-age person. p – level of significance. a, b, c – statistically significant differences in pairs. ( ) – population size.

Table 5. Selected socioeconomic and lifestyle characteristics vs. 10-year fracture risk, % of the sub-sample

Socioeconomic characteristics	Sub-sample	Terciles RB-10			p
		T1	T2	T3	
1	2	3	4	5	6
Marital status	(267)	(64)	(112)	(91)	< 0.001
– married/with partner	51	77^{ac}	54^{ab}	31^{bc}	
– lonely	49	23^{ac}	46^{ab}	69^{bc}	
Lives	(261)*	(64)	(109)	(88)	< 0.001
– alone	27	11^{ab}	27^{a}	39^{b}	
– with someone	73	89^{ab}	73^{a}	61^{b}	
Level of education	(267)	(64)	(112)	(91)	NS
– basic	48	44	46	54	
– medium	43	47	46	37	
– higher	9	9	9	9	

Table 5 – cont.

1	2	3	4	5	6
The economic situation	(267)	(64)	(112)	(91)	NS
– good	21	19	23	20	
– average	67	73	64	67	
– poor	11	8	13	13	
The level of physical activity	(267)	(64)	(112)	(91)	< 0.05
– small	33	31	26[c]	42[c]	
– moderate	39	31[a]	47[ac]	33[c]	
– large	29	38	27	25	
Supplementation	(267)	(64)	(112)	(91)	< 0.01
YES	41	27[b]	38[c]	54[bc]	
State of health	(267)	(64)	(112)	(91)	< 0.05
– good/very good	19	25[b]	22	12[b]	
– average	62	64	63	60	
– bad/very bad	18	11[b]	15[c]	27[bc]	
Chronic diseases	(267)	(64)	(112)	(91)	NS
YES	88	83	90	90	
Current smoking	(267)	(64)	(112)	(91)	NS
YES	8	9	4	12	
Alcohol abuse	(108)**	(29)	(38)	(41)	< 0.05
YES	6	0[b]	3	15[b]	

*No data for 6 people.
**No data for 159 people.
RB-10 – absolute 10-year fracture risk. T1, T2, T3 – tertile intervals. p – level of significance. NS – insignificant differences. a, b, c – significant differences in pairs. ( ) – sample size.

Table 6. Odds ratio (OR) and 95% confidentiality interval (95% CI) for the relationship between socioeconomic and lifestyle characteristics and RB-10

Socioeconomic characteristics	OR (95% CI)		
	T1 RB-10	T2 RB-10	T3 RB-10
Marital status (married/with partner)	1.00	0.35* (0.18-0.71)	0.14* (0.07-0.28)
Lives (with someone)	1.00	0.34* (0.14-0.83)	0.20* (0.08-0.48)
The level of physical activity (large)	1.00	0.68* (0.47-0.99)	0.80 (0.53-1.20)
Supplementation (yes)	1.00	1.61 (0.84-3.12)	3.23* (1.61-6.47)
State of health (good/very good)	1.00	0.98 (0.68-1.43)	0.86 (0.57-1.30)
Alcohol abuse (yes)	1.00	0.66 (0.36-1.22)	1.22 (0.69-2.15)

T1, T2 and T3 RB-10 – tertile intervals for absolute 10-year fracture risk.
*$p < 0.05$.

and T3: OR = 0.20, 95% CI: 0.08-0.48) and in people with a high physical activity (T2: OR = 0.68, 95% CI: 0.47-0.99), whereas it was higher in subjects taking dietary supplement (T3: OR = 3.23, 95% CI: 1.61-6.47).

A significant reverse relationship was shown to exist between BMD and parameters which characterised 10-year fracture risk ($p < 0.001$, Fig. 1). Both the risk and probability of fracture decreased with increasing mineral bone density for the sample under examination, with the changes being the most apparent in the change pattern of RB-10. RB-10 was equal to 38% for the lower tertile of BMD, 27% for the middle tertile of BMD and 21% for the upper tertile of BMD. A less rapid, but still significant, decrease in BMD was observed for $RB\text{-}10_{pf}$ and $RB\text{-}10_{af}$.

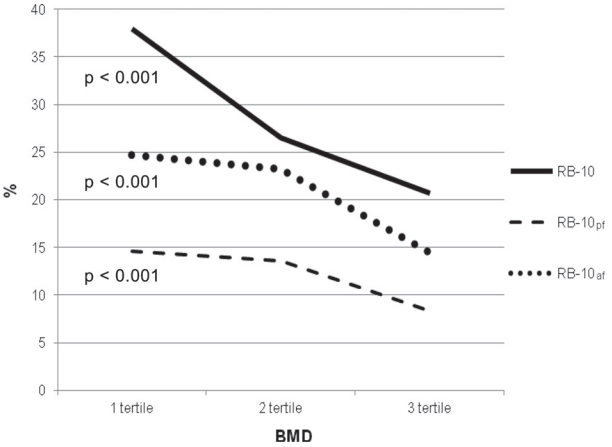

Fig. 1. Average risk and probability of osteoporotic fracture vs. bone mineral density: RB-10 – absolute 10-year fracture risk, $RB\text{-}10_{pf}$ – 10-year probability of proximal femoral fracture, $RB\text{-}10_{af}$ – 10-year risk of any fracture, BMD – bone mineral density, p – level of significance

DISCUSSION

This study confirmed more than twice higher risk and probability of osteoporotic fracture in women as compared to men, which has been shown to exist in people aged 65-85 in Switzerland [Lippuner et al. 2009]. This study found women to have lower bone mineral density than men, which has also been observed by other authors [Cawthon 2011, Dawson-Hughes et al. 2008]. According to Nguyen et al. [2007], the life risk of fracture in 60-year-old women is close to 44% and it is nearly twice as high as for men of the same age (25%). A significant role is probably played not only by the difference in BMD, but also by the size and geometry of bones in both sexes [Sigurdsson et al. 2006]. In this study, the average value of T-score BMD in the distal part of the forearm for male subjects was –0.6. A similar value of T-score BMD has been observed in men aged 60+ years from Belgium and France, i.e. –0.5, for which densitometry measurements were made at the proximal end of the femur [Scholtissen et al. 2009]. This study has shown the risk of osteopenia and osteoporosis to exist in 37% and 9% male subjects, respectively. The percentage was much higher in the study conducted by Scholtissen et al. [2009], where it was equal to 51% and 22%.

The socioeconomic factors which affect the condition of bones in healthy subjects has rarely been the object of interest of Polish or foreign researchers. This study has shown that marital status is significantly associated with the risk of osteoporotic fracture. It has been found based on the logistic regression analysis that the probability of the presence of the middle and the upper tertile of fracture risk was lower by 65% and by 86% in people who have a spouse or a partner than single and lower by 66% and 80% in people who living with someone than living alone. Similar results were observed by Robbins et al. [2007]. It was found in that study that single women suffered from a hip fracture significantly more frequently than married ones.

The NHANES study [Robitaille et al. 2008] showed nearly twice higher incidence of osteoporosis among women who took calcium and/or vitamin D supplementation than among those who did not. It has been observed in this study that the risk of the upper tertile of RB-10 was nearly thrice higher in the subjects who declared taking vitamin and/or mineral supplements as compared with those who did not. Taking dietary supplements in the group particularly susceptible to osteoporotic fracture may have been recommended by a doctor and the supplementation period was too short to produce the desired pro-health effect. In this study, the health condition of the subjects has been shown to affect the risk of osteoporotic fracture. For more than twice the percentage of people declared bad health compared to those with a satisfactory state

of health (27% vs. 12%) 10-year risk of fracture was located in the upper tertile. The relationship of this has not been confirmed, however, in logistic regression analysis. Robbins et al. [2007] also taken into account the state of health of the risk factors associated with 5-year risk of a hip fracture in post-menopausal women. In that study, the women who evaluated their health status as being bad had higher risk of fracture and suffered from fractures more frequently as compared to women with very good health.

Many authors have pointed out a significantly positive effect of physical activity on bone mineral density and the negative effect on the risk and frequency of fractures [Muraki et al. 2007, Robbins et al. 2007, Robitaille et al. 2008, Moayyeri 2008, Kemmler et al. 2012]. An active lifestyle in women aged 65+ with osteopenia was associated with 30-50% reduction of femoral neck fractures [Kemmler et al. 2012]. According to Moayyeri [2008], an increase in physical activity reduces the fracture risk by as much as 2/3. In this study, those who reported high physical activity had a 32% lower 10-year risk of fracture in the middle tertile than those who reported low physical activity.

In this study it was not reported that smoking significantly increases the risk of osteoporotic fracture. The literature review shows that both active and passive smoking are independent risk factors for the development of osteoporosis [Altunbayraka et al. 2009, Compston 2007]. Robbins et al. [2007] have shown smoking women to suffer from femoral neck fracture twice as frequently and to suffer from fractures more frequently than women who have never smoked. Muraki et al. [2007], in a study with women aged 60+ from Tokyo, pointed to significantly higher mineral density in women non-smokers as compared with women smokers (808 mg/cm^2 vs. 772 mg/cm^2). Similar results were observed by Tamaki et al. [2011], who examined men aged 65+. The value of BMD in that study was equal to 892 mg/cm^2 in non-smoking men and 878 mg/cm^2 in smokers, but it was not statistically significant. Moreover, a reverse relationship was observed between BMD and the number of years of smoking and the number of cigarettes smoked during a year [Tamaki et al. 2011]. It was shown that the mechanism of action of tobacco smoke involves weakening of the activity of osteoblasts and inhibition of contractions of bone cells of collagen, which increases bone brittleness [Giampietro et al. 2010].

Although the logistic regression analysis does not confirm that alcohol abuse significantly affects the risk of osteoporotic fracture, a study conducted by Kouda et al. [2011] found a positive relationship between alcohol consumption in the amount of up to 55 g/day and the average value of BMD. Alcohol consumption in larger amounts was negatively correlated with bone mineral density. People who only occasionally consume alcohol in moderate amounts had significantly higher BMD than teetotallers (842 mg/cm^2 vs. 792 mg/cm^2) [Muraki et al. 2007], a lower risk of femoral neck fracture [Berg et al. 2008] and suffered from injuries less frequently [Robbins et al. 2007].

The effect of alcohol consumption and tobacco smoking on the condition of bones has not been fully elucidated. A study conducted by Scholtissen et al. [2009] did not reveal any relationship between smoking or alcohol consumption and BMD. The absence of any effect of those factors on the risk of fracture has been shown also by Clark et al. [2012] in a study with menopausal women. In this study, evaluation of the interactions between the fracture risk and smoking and alcohol consumption was limited to the current presence of those factors. Slightly increased risk of RB-10 in the middle tertile in the group of those currently not smoking may have resulted from smoking addiction in the past.

It has been shown for elderly people, as has already been shown for the population of men and women over 50 years old in Poland, that the absolute 10-year fracture risk increases with a decrease in mineral bone density [Czerwinski et al. 2009]. This tendency was also observed in men and women aged 65-85 years in Switzerland [Lippuner et al. 2009]. That study showed that when the bone mass is correct (T-score ≥ -1), the risk of any fracture was only 7%; when the T-score was between –2.5 and –1 approx. 16%, and when T-score < -2.5 – as much as 35% [Lippuner et al. 2009]. This relationship has also been observed by Mackey et al. [2007] in a study with a group of people aged 65 years and older from different geographic regions, where the risk of fracture was especially increased in subjects with T-score BMD ≤ -2.5. A BMD decrease by 1SD was associated with a 50% increase in the risk of osteoporotic fracture in women and a 67% increase in such risk in men [Mackey et al. 2007].

CONCLUSIONS

10-year fracture risk in people aged 65+ years from small towns in the north-east of Poland was more than twice higher in the female than in the male subjects. The females had also significantly lower mineral bone density and a higher probability of thigh bone fracture and probability of any fracture than males. The group with the highest fracture risk had tenfold more people with very low bone mineral density. Of the socioeconomic and lifestyle factors, marital status, living (with someone), physical activity and taking supplementation proved to be the strongest predictors of the 10-year fracture risk. The lowest 10-year fracture risk was observed in people who have a spouse or a partner and living with someone and was higher in those taking supplementation and have a low physical activity.

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CECHY SOCJOEKONOMICZNE I ELEMENTY STYLU ŻYCIA A 10-LETNIE RYZYKO ZŁAMANIA U OSÓB W WIEKU 65+ ZAMIESZKAŁYCH W MAŁYCH MIASTACH POLSKI PÓŁNOCNO-WSCHODNIEJ. PROJEKT SENFOOD

STRESZCZENIE

Wprowadzenie. W badaniu oceniono występowanie współzależności pomiędzy wybranymi cechami socjoekonomicznymi i elementami stylu życia a 10-letnim ryzykiem złamania u osób w wieku 65+, zamieszkałych w środowisku małych miast Polski północno-wschodniej.

Metodyka. Badaniami objęto 267 osób (76 mężczyzn i 191 kobiet) w wieku 76,9 ±2,5 lat z małych miast Polski północno-wschodniej, żyjących w samodzielnych gospodarstwach domowych. Podstawowe informacje dotyczące sytuacji socjoekonomicznej i stylu życia badanych zebrano podczas indywidualnego wywiadu *face to face*. Metodą podwójnej absorpcjometrii rentgenowskiej (DXA) zmierzono gęstość mineralną tkanki kostnej (BMD) w dystalnej części przedramienia. Obliczono absolutne 10-letnie ryzyko złamania kości zgodnie z algorytmem opracowanym przez WHO oraz IOF [Kanis i in. 2005].

Wyniki. Kobiety w porównaniu z mężczyznami miały istotnie wyższe średnie 10-letnie ryzyko złamania (odpowiednio 31,4% vs 14,5%), prawdopodobieństwo złamania kości udowej (odpowiednio 13,7% vs 6,1%) i jakiegokolwiek złamania (odpowiednio 23,9% vs 10,1%) oraz mniejsze BMD (odpowiednio 290,6 mg/cm^2 vs 405,2 mg/cm^2). Wyższe 10-letnie ryzyko złamania miały osoby stosujące suplementy diety (T3 RB-10: OR = 3,23; 95% CI: 1,61-6,47), a niższe cechowało osoby żyjące ze współmałżonkiem/ką lub z partnerem/ką (T3 RB-10: OR = 0,14; 95% CI: 0,07-0,28), mieszkające z kimś (T3 RB-10: OR = 0,20; 95% CI: 0,08-0,48) oraz o dużej aktywności fizycznej (T2 RB-10: OR = 0,68; 95% CI: 0,47-0,99).

Wnioski. 10-letnie ryzyko złamania było istotnie związane z płcią. U kobiet stwierdzono mniejszą gęstość mineralną kości oraz ponad dwukrotnie wyższe 10-letnie ryzyko złamania, prawdopodobieństwo złamania kości udowej i jakiegokolwiek złamania w porównaniu z mężczyznami. 10-letnie ryzyko złamania było wyższe u osób niezamężnych/nieżonatych, mieszkających samotnie, o małej aktywności fizycznej i stosujących suplementację.

Słowa kluczowe: 10-letnie ryzyko złamania, gęstość mineralna kości, osoby starsze, styl życia, cechy socjoekonomiczne

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