PRACA ORYGINALNA

Skeletal status in subjects with poor visual acuity in independent and institutionalized subjects

Stan szkieletu u osób z niedowidzeniem mieszkających samodzielnie oraz w domach opieki

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ABSTRACT

AIM

The aim of the study was to evaluate skeletal status in subjects with poor vision.

MATERIAL AND METHODS

Skeletal status was assessed in a group of subjects with poor visual acuity living independently in general community or institutionalized in a nursing home. A group of 91 subjects (47 females - 29 living independently and 18 from nursing home and 44 males - 19 and 25, respectively) were studied. Mean age was 61.3+/-16.8 y. in females and 61.4+/-10.9 y. in males. Binocular visual acuity was evaluated using a Snellen acuity chart. Skeletal status was assessed by dual-energy X-ray absorptiometry at the calcaneus and forearm using PIXI (Lunar, USA) which measures bone mineral density (BMD) and by quantitative ultrasound at hand phalanges using DBM Sonic 1200 (IGEA, Italy) measuring Amplitude-dependent Speed of Sound (Ad-SoS [m/s]).

RESULTS

Binocular visual acuity was 0.179+/-0.2 in females and 0.09+/-0.14 in males and was significantly lower in males ($p<0.01$). A visual acuity did not correlate with skeletal variables in either of sexes and was significantly lower in males from nursing home in comparison to males living independently ($p<0.001$) what was not observed in females. Z-scores were used in order to obtain age-adjusted comparisons of skeletal variables between subjects living independently and in nursing home. In females Z-scores for forearm (-0.304+/-0.92 vs −1.044+/-0.74, $p<0.01$) and calcaneus (-0.017+/-0.97 vs −1.38+/-0.63, $p<0.00001$) were significantly higher

in individuals living independently than in nursing home, and Z-score for Ad-SoS did not differ significantly. In males no significant differences in Z-scores were noted.

CONCLUSION

The results of the study suggest that in both genders fracture risk in institutionalized subjects may be increased; in females due to affected skeletal status, and in males as a consequence of poor vision.

KEYWORDS

bone densitometry, poor vision, quantitative ultrasound

STRESZCZENIE

CEL PRACY

Celem pracy była ocena stanu szkieletu u osób z niedowidzeniem.

MATERIAŁ I METODY

Stan szkieletu oceniano w grupie osób żyjących samodzielnie oraz mieszkańców domów pomocy społecznej (DPS). Zbadano 91 osób (47 kobiet – 29 mieszkających samodzielnie i 18 z DPS -ów oraz 44 mężczyzn – odpowiednio 19 i 25). Średni wiek to 61,3+/-16,8 u kobiet i 61,4+/-10,9 lat u mężczyzn. Obuoczną ostrość wzroku badano przy pomocy tablicy Snellena. Badania szkieletu obejmowały pomiar densytometryczny przy pomocy dwuwiązkowej absorpcjometrii rentgenowskiej (DXA) pięty i przedramienia (Lunar, USA) oraz pomiar metodą ultradźwiękową paliczków dłoni DBM Sonic 1200 (IGEA, Italy), mierząc prędkość fali ultradźwiękowej zależnej od amplitudy (Amplitude-dependent Speed of Sound (Ad-SoS [m/s]).

WYNIKI

Obuoczna ostrość wzroku wyniosła 0,179+/-0,2 u kobiet i 0,09+/-0,14 u mężczyzn i była istotna statystycznie mniejsza u mężczyzn (p<0,01). Ostrość wzroku nie korelowała z parametrami szkieletowymi i była istotnie niższa u mężczyzn z DPS-ów w porównaniu do mężczyzn żyjących samodzielnie (p<0,001), czego nie zanotowano u kobiet. Z-score, jako parametr niezależący od wieku zastosowano dla porównania. U kobiet Z-score przedramienia (-0,304+/-0,92 versus –1,044+/-0,74, p<0,01) i pięty (-0,017+/-0,97 versus –1,38+/-0,63, p<0,00001) były istotnie wyższe u kobiet żyjących samodzielnie względem kobiet z DPS-ów, a Z-score dla Ad-SoS nie różnił się. U mężczyzn brak było różnic ze względu na miejsce zamieszkania.

WNIOSKI

Wyniki pracy sugerują, że u kobiet i mężczyzn żyjących w domach opieki społecznej ryzyko złamań może być zwiększone; u kobiet w wyniku zaburzeń szkieletu, a u mężczyzn w efekcie niedowidzenia.

SŁOWA KLUCZOWE

densytometria, niedowidzenie, ilościowa metoda ultradźwiękowa

INTRODUCTION

The risk for fractures in subjects with visual impairment is increased due to enhanced risk of falls as was shown in some studies (1–3). In several studies the association of hip fracture and visual impairment was examined (4 –7). In the majority of them a poor visual acuity increased risk of hip fracture (4, 6, 7) while in one

study this observation was not confirmed (5). Visual problems may also increase the number of falls (8, 9). One of the most important risk factors for fracture is a decreased bone mineral density (BMD) (10). Low physical activity or diminished sunlight exposure in subjects with visual impairment may also affect bone status and additionally increase risk for fracture.

In studies recently published low values of quantitative ultrasound (QUS) measurements at the calcaneus (11, 13) and hand phalanges (13-15) are associated with enhanced risk of osteoporotic fractures. This method is now widely evaluated and used worldwide due to its features like relatively low cost, the lack of ionizing radiation and portability of devices.

In the current study we attempt to assess skeletal status in subjects with a decreased visual acuity. The subjects of our interest were females and males living in community and in nursing home. Inhabitants of nursing home account for approximately 40% of total hip fractures (l6) and therefore this group ought to be more extensively investigated. In some studies factors associated with vision were studied in elderly institutionalized people (17, 18). The aim of current study was to evaluate the associations between poor visual acuity, bone health and fracture rate in elderly residents of nursing homes and their age-matched peers living in general community. The analysis of such relationships between vision impairment and skeletal status would provide new data about the effect of this common disability on osteoporosis risk.

cruited from persons registered in Polish Blind Association in Zabrze or Nursing Home in the same urban area. The reasons of impaired vision were: retinal disorders (n = 22), glaucoma (n = 21), short-sightedness (n = 19), congenital disorders (n = 9), optic nerve or optic pathway disorders (n = 9), other in 11. Mean age in the whole group was 61.3 +/-14.2 y. (61.3+/-16.8 y. in females and 61.4+/-10.9 y. in males). In all subjects no reasons with potential influence on bone metabolism (prolonged diseases or medications) and therapy for osteoporosis currently or earlier were noted. The whole group was divided according to place of living and subgroups are presented in **Table 1**. In females 27 women had sedentary work and 20 were manual workers and in males 33 and 11, respectively. In females 11 fractures due to low trauma equivalent to fall from a standing height and in males 4 such fractures occurred (majority of fractures were forearm fracture). Mean period of stay in nursing home was 10.8 +/-4.5 y.

METHODS

Skeletal status was assessed by dual-energy X-ray absorptiometry (DXA) at the calcaneus and forearm using PIXI (Lunar, Madison, USA) which measures BMD [g/cm^2]. All

Table 1. Clinical characteristics of subgroups studied (mean +/-SD)				
	Females living in community n = 29	Females from nursing home n = 18	Males living in community n = 19	Males from nursing home n = 25
Age [y.]	55.9+/-13.7	70.1+/-17.9	58.2+/-10.0	63.8+/-11.2
Weight [kg]	69.9+/-10.9	67.6+/-13.1	76.2+/-14.1	73.9+/-15.6
Height [cm]	162.0+/-5.3	157.9+/-8.5	171.7+/-7.7	168.6+/-10.2

ity, bone health and fracture rate in elderly residents of nursing homes and their age-matched peers living in general community. The analysis of such relationships between vision impairment and skeletal status would provide new data about the effect of this common disability on osteoporosis risk.

MATERIAL AND METHODS

SUBJECTS

In the study 91 residents with poor vision (44 males and 47 females) were included. Poor vision was determined when visual acuity was ≤0.2. All subjects studied were randomly re-

subjects studied had the right dominant side and measurements were performed at the right side. In a case of past fracture at forearm opposite side was measured. Because of the lack of normative data for male forearm measurements in wide age range Z-score for this site was not taken into consideration. DXA measurements were performed by one operator. Precision of the method expressed using coefficient of variation (CV) was 1.5% for forearm and 2.0% for calcaneus measurements.

Skeletal status was also assessed by ultrasound measurements of proximal phalanges using DBM Sonic 1200 (IGEA, Carpi, Italy). This unit consists of two probes mounted on an electronic caliper, one emitter and one re-

ceiver. The last records the ultrasound energy after it has crossed the phalanx. We determined the amplitude-dependent speed of sound (Ad-SoS [m/s]) in the distal metaphyses of the proximal phalanges of the second through fifth finger of the dominant hand. Speed of sound in bone tissue was calculated considering the first signal with amplitude of at least 2mV at the receiving probe; thus, the measured speed of sound is amplitude dependent. Acoustic coupling was achieved using a standard ultrasound gel.

All measurements were done by the same operator. In vivo CV% was 0.64%.

Visual acuity was measured using a Snellen visual acuity chart at constant illuminium, while the participant was wearing his or her current eyeglasses to correct for distance. A visual acuity was available for each eye. Visual acuity was categorized according to proposition given by Felson et al. (4). Mean current visual acuity was poor what equivalent to 0.2 or worse. Ophthalmologic examination was performed by an experienced specialist in this area.

STATISTICS

The statistical analysis was performed using Statistica for Windows. Shapiro-Wilk test was used for assessing the data distribution. All variables had normal distribution. Comparisons were performed by Student's T-test or Mann-Whitney test for parametric or nonparametric variables, respectively. Statistical significance was achieved with p values below 0.05.

RESULTS

Binocular visual acuity was 0.136+/-0.18, 0.179+/-0.2 and 0.09+/-0.14 in whole group, in females and males, respectively. Visual acuity was significantly lower in males in comparison to females (p<0.01). As occupation and presence of previous fracture did not affect the results within subgroups of males and females (data not shown) analysis was performed for all males and all females. Results in densitometric and ultrasound measurements are given in **Tables 2** and **3**. In order to obtain age-adju-

Table 2. Results of skeletal measurements and visual acuity in female subgroups
(only Z-scores values compared in order to avoid the influence of differences in age)

Variable	Females from nursing home n = 18	Females living in community n = 29
Ad-SoS [m/s]	1895+/-80	1977+/-103
T-score	-3.27+/-1.15	-2.08+/-1.48
Z-score	-0.69+/-1.19	-0.71+/-0.97
Forearm BMD [g/cm^2]	0.303+/-0.08	0.429+/-0.06
T-score	-3.089+/-1.33	-0.933+/-1.25
Z-score	-1.044+/-0.74*	-0.304+/-0.92
Calcaneal BMD [g/cm^2]	0.319+/-0.08	0.492+/-0.1
T-score	-2.26+/-1.01	-0.214+/-1.17
Z-score	-1.38+/-0.63**	-0.017+/-0.97
Binocular visual acuity [0-1.0]	0.164+/-0.22	0.188+/-0.19

A significant difference between subgroups *p<0.01, ** p<0.00001

Table 3. Results of skeletal measurements and visual acuity in male subgroups
(only Z-scores values compared in order to avoid the influence of differences in age)

Variable	Males from nursing home n = 25	Males living in community n = 19
Ad-SoS [m/s]	1979+/-77	2010+/-67
T-score	-2.08+/-1.1	-1.63+/-0.97
Z-score	-1.12+/-1.04	-0.78+/-1.0
Forearm BMD [g/cm^2]	0.458+/-0.09	0.520+/-0.08
T-score	-2.104+/-1.52	-1.079+/-1.34
Calcaneal BMD [g/cm^2]	0.468+/-0.13	0.562+/-0.12
T-score	-1.692+/-1.44	-0.637+/-1.38
Z-score	-1.079+/-1.26	-0.347+/-1.4
Binocular visual acuity [0-1.0]	0.028+/-0.05*	0.171+/-0.171

* significant difference between subgroups p<0.001

sted comparisons of skeletal variables between subjects living in community and in nursing home Z-scores were used. In females Z-score values for forearm (-0.304+/-0.92 vs –1.044+/- 0.74, p<0.01) and calcaneus (-0.017+/-0.97 vs –1.38+/-0.63, p<0.00001) were significantly higher in individuals living independently than in nursing home, and Z-score for Ad-SoS did not differ significantly. In males no significant differences in Z-scores for calcaneal BMD and Ad-SoS were noted [Z-score for forearm BMD was not available]. Visual acuity did not correlate with skeletal variables in both sexes and was significantly lower in males from nursing home in comparison to males living independently (p<0,001) what was not observed in females.

DISCUSSION

The current study provided data which do not confirm the thesis that poor vision has an influence on skeletal status. Moreover, different trends in comparisons of skeletal variables in females and males suggest that factors underlying skeletal status are gender-dependent. To our knowledge, this is the first study yet published concerning subjects with poor vision which compares densitometric and ultrasound data in both sexes with regard to the place of living. Different factors had an impact on skeletal status in both sexes; in females factors apparently connected with living in nursing home influenced skeletal status (in the absence of difference in visual acuity) while in males from nursing home skeletal variables did not differ significantly despite a difference in visual acuity. Due to low skeletal variables in females from nursing home the future risk for fracture may be increased. In males, irrespective of comparable skeletal status in subjects living independently and institutionalized poor vision may contribute to fracture risk in latter group.

Zochling and al. (19) performed calcaneal QUS measurements in a great group of institutionalized elderly men and women. Compared with healthy women and men living in the general community the mean Broadband Ultrasound Attenuation was 1.2 and 0.8 standard deviation lower in the institutionalized women and men, respectively. In our study Z-score values for Ad-SoS were almost the same in fema-

les, and only a small insignificant difference in Z-score (0.34) for this parameter in men were noted. It is difficult to directly compare our results with data given by Zochling et al. because their subjects were older and other skeletal site was measured. Interesting data were provided by Krieg et al. (20) who conducted calcaneal QUS measurements in institutionalized elderly women. In this study compared with other population results in elderly institutionalized women without fractures were as low as a group of women at the same age with hip fracture (21). In our study Ad-SoS did not differ significantly between institutionalized and not-institutionalized subjects. Mean age of women studied in quoted French study was around 85 y. while our subjects were much younger and this factor is probably responsible for the lack of difference in Ad-SoS values. Hand phalanges consisting mostly of cortical bone are more sensitive rather to change in older age. However, BMD measurements at forearm and calcaneus expressed in Z-scores were lower in our females from nursing home in comparison to females living in general community.

In studies designed to assess the role of poor vision - commonly risk of falls (1–3) or hip fracture rate in women - were evaluated (4–7). We did not find any yet published study aimed to compare skeletal and ophthalmologic data in populations similar to our group. We may only create a hypothesis that females from nursing home due to lower BMD values may have a high risk of suffering fracture but this risk is not, as expected, connected with poor visual acuity. In males the view provided by our study is even more unexpected; despite differences in visual acuity and various place of living, fracture risk based on skeletal measurements was comparable in both subgroups studied. These observations suggest necessity of further investigations able to assess several other factors (activity of daily living, falls rates, diet etc.). Another possible explanation of current results is that poor vision probably mainly contributes to the increase in hip fracture risk due to increase in falls rate, and other postulated mechanisms like low physical activity or diminished sun exposure do not play a significant role. This thesis supports also the analysis performed by Espallargues and al. (22) who classified factors for fracture related to bone mass loss. Among them poor vision was not placed among significant risk factors, and low physical activity was classified as a high and low

sun exposure as a moderate risk factor. Prior to the study we suspected that poor vision will act on skeletal status through an influence on these factors but we did not prove it.

The role of poor vision was recently assessed in great French study (23). In a sample of 14.603 subjects low vision was one of independent factors associated with mortality. In other studies some interventions were evaluated aimed at decreasing the risk of falls in subjects with visual impairment (24, 25). Providing of single lens glasses for older wearers of mulitifocal glasses who take part in regular outdoor activities was an effective falls prevention strategy (24). Other authors provide evidence that use of single-vision distance lenses in everyday locomotion may be advantageous for elderly multifocal glasses wearers who have a risk of falling (25).

Our study has several limitations: small groups, cross-sectional design, the lack of other features of impaired vision besides visual acuity and the lack of laboratory data, especially vitamin D status. We also did not gather information on the number of falls in the past. At the time of evaluation subjects from nursing home or general community with good visual acuity were not available and further comparisons were not possible.

Concluding, results of the study suggest that in both genders future fracture risk in institutionalized subjects may be increased; in females due to affected skeletal status, and in males as a consequence of poor vision.

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