Rocz Panstw Zakl Hig 2013;64(2):97-104

# DIETARY INTAKES OF IRON AND ZINC ASSESSED IN A SELECTED GROUP OF THE ELDERLY: ARE THEY ADEQUATE?

*Dawid Madej[1], Katarzyna Borowska[1], Justyna Bylinowska[1], Aleksandra Szybalska[2], Barbara Pietruszka[1]*

[1]Faculty of Human Nutrition and Consumer Sciences, Warsaw University of Life Sciences, Warsaw, Poland
[2]The International Institute of Molecular and Cell Biology, Warsaw, Poland

## ABSTRACT

**Background.** Many studies demonstrate that the elderly consume a nutritionally inadequate diet that includes deficiencies in macro- and microelements; iron and zinc being significant examples of the former.
**Objectives.** To assess the adequacy of dietary iron and zinc intakes in the elderly.
**Material and methods.** The study was conducted on n=102 elderly persons, participating in the PolSenior Project, aged over 65, of which 44 were women and 58 men. Consumption data were collected by using 3 day dietary record from which a usual intakes of energy, macroelements (iron and zinc) were calculated. The Estimated Average Requirement (EAR) cut point and z-scores methods were used to determine probabilities of whether iron and zinc uptake was adequate per subject.
**Results.** By using the EAR cut-point method it was stated that iron intake was inadequate for 5% of respondents, whereas 44% showed deficits in zinc (34% women and 52% men). The z-scores demonstrated that 3% of subjects had high probabilities of deficiencies in iron and 52% in zinc. Indeed, very high zinc deficiencies were observed in 20% of cases.
**Conclusions.** The insufficient energy intake observed among respondents contributes to a high risk of zinc deficiency necessary to ensure health in the elderly. In most cases, the low risk of iron deficiency shows that there is no need to increase this nutrient uptake in the examined group of elderly. The study highlights the need for educating the elderly, especially focused on improving zinc intake without changing iron intake. It can be done through appropriate dietary choices so as to include products such as dairy products, wheat bran, pumpkin and sunflower seeds, beans, lentils and nuts.

**Key words:** *elderly people, iron, zinc, intake, EAR cut-point method, PolSenior project*

## STRESZCZENIE

**Wprowadzenie.** Wyniki wielu badań wskazują, że dieta osób starszych jest często nieadekwatna do ich zapotrzebowania. Istotne znaczenie ma odpowiednie spożycie makro- i mikroelementów w tym, m.in. żelaza i cynku.
**Cel.** Celem niniejszych badań była ocena spożycia żelaza i cynku przez osoby starsze.
**Materiał i metody.** Badania przeprowadzono wśród 102 osób w wieku ponad 65 lat (44 kobiety, 58 mężczyzn), uczestników projektu PolSenior. Dane o spożyciu zostały zebrane metodą 3-dniowego bieżącego notowania, na podstawie których obliczono wartość energetyczną racji pokarmowych oraz zwyczajowe spożycie makroskładników, żelaza i cynku. Ocenę adekwatności spożycia żelaza i cynku przeprowadzono metodą punktu odcięcia (*Estimated Average Requirement* - EAR cut-point) oraz określając prawdopodobieństwo nieprawidłowego spożycia żelaza i cynku na poziomie indywidualnym z wykorzystaniem współczynnika z-score.
**Wynik.** Ocena adekwatności spożycia badanych pierwiastków metodą EAR cut-point wykazała w przypadku żelaza, iż dla 5% badanych zwyczajowa dieta nie pozwoliła na realizację normy na żelazo na poziomie średniego zapotrzebowania w grupie (EAR), natomiast w przypadku cynku aż u 44% badanych (34% wśród kobiet i 52% wśród mężczyzn). Oceniając prawdopodobieństwo niedostatecznego spożycia wykazano, że duże prawdopodobieństwo niedoborów żelaza wystąpiło jedynie u 3% osób, natomiast w przypadku cynku u około 52% osób, przy czy bardzo wysokie ryzyko dotyczyło 20% badanej populacji.
**Wnioski.** Zbyt niska wartość energetyczna diet badanych osób powyżej 65 roku życia stwarza ryzyko wystąpienia niedoborów cynku w diecie osób starszych. Ze względu na niewielkie ryzyko wystąpienia niedoboru żelaza w diecie osób starszych nie ma potrzeby poprawy spożycia tego składnika wśród badanych osób. W celu zwiększenia pobrania cynku przez te osoby bez zmiany pobrania żelaza zaleca się większe spożycie produktów, takich jak mleko i przetwory mleczne, otręby pszenne, nasiona dyni i słonecznika, fasola, soczewica czy orzechy.

**Słowa kluczowe:** *osoby starsze, żelazo, cynk, spożycie, metoda punktu odcięcia, projekt PolSenior*

**Corresponding author**: Dawid Madej, Faculty of Human Nutrition and Consumer Sciences, Warsaw University of Life Sciences, Nowoursynowska Street 159c, 02-776 Warsaw, Poland, phone +48 22 59 37 114, fax +48 22 5937117, e-mail: dawid_madej@sggw.pl

## INTRODUCTION

Nutrition in the elderly shows many shortcomings. Deficiencies or an excess intake of essential minerals may give rise to various disorders [1]. Dietary iron and zinc are particularly important to those aged over 65 years. Iron is vital to the body's oxygen management and in DNA synthesis. Deficiencies of this element result in general physiological and mental weakness as well as anaemia. Both iron and zinc play crucial roles in immunity and thus any inadequate intake increases the risk of infection [15]. Zinc deficiencies in the elderly may cause disorders of gustation and taste, slowing brain activity, depression and impaired healing of wounds [16, 18]. So considering how important iron and zinc are in the diet of the elderly, studies on their intakes are therefore merited.

## MATERIAL AND METHODS

The study subjects were 102 elderly persons, aged 65-95 years, living in the Wielkopolska and Pomeranian provinces (voivodships) in Poland. They formed part of a larger study (PolSenior; n=824 subjects), for which nutritional data had been gathered before January 2011. Criteria for inclusion were following: being a resident in the aforementioned areas and correct completion of a 3-day record. The survey was performed by specially trained staff and included taking socio-demographic data (i.e. age, gender, place of residence, marital status and education), anthropometric data (height, body mass), and a self-assessment of the individual's state of health. Full details of the PolSenior project can be found in reference [5].

Food consumption data were recorded over 3 consecutive days that included a day of the weekend. The nutritional value of the daily food rations eaten throughout this time was assessed by the 'Dieta 4D' computer programme. Respondents evaluated consumed portions using household measures. These were then transformed into weighted amounts, using a photographic album denoting the actual sizes of foodstuffs and their related products [21]. The nutritional value of these diets was also determined by means of the 'Dieta 4D' programme upon which an operational 10% loss of iron and zinc was analytically accounted for. Also taken into consideration were the intakes of these minerals through dietary supplements.

The method of *Carriquiry* [6] was used to estimate usual nutrients intakes on the basis of observed individual energy, protein, fats, carbohydrates, iron and zinc intakes. Two procedures were used to establish whether the dietary intake of iron and zinc was adequate: the EAR cut-point method and through determining the probability of their consumption being abnormal relative to physiological requirements. The numbers of subjects consuming iron and zinc below the median of requirements - EAR values for the study group was then calculated by the former method, whose correct application needed a symmetrical distribution of physiological requirement values around the EAR; this condition being met in the case of zinc. Similarly, this trend was also observed in the corresponding iron values from the group of elderly, so also for postmenopausal women [6, 16], thus allowed the method to be also used here [7, 9]. The second method calculated z-scores to determine the probability of whether individual iron and zinc consumption was inadequate. For iron, this assessment was performed relative to tabular data from a study by *Otten* et al. [16] showing the probabilities of abnormal iron consumption in defined population groups. In the case of zinc, the *z-scores* were calculated according to the following equation, adopting a 10% coefficient of variation for its physiological requirement values.

$$\text{z-score} = D/SD_D = (y - EAR)/\sqrt{SD_z^{\,2} + (SD_S^{\,2}/n)}$$

where:
D - difference between observed individual intake/ consumption (y) and the average EAR value
$SD_D$ - standard deviation of D
y - observed individual intake
$SD_z^2$ - group's requirement variance
$SD_s^2$ - the individual's requirement variance
N - number of days that intake was assessed

*Statistical analysis*

This was performed by the 'STASITICA 9.1 PL' programme. The *Spearman* correlation coefficient was used to evaluate the relationships between dietary energy values and the amounts of macro-ingredients with the customary intake values of iron and zinc. The significance of differences between qualitative variables was measured by the $Chi^2$ test, whilst the t-test was used for quantitative variables i.e. on the differences in the amounts of various dietary ingredients. The critical value of $p<0.05$ was taken as being statistically significant.

Additionally, using the logistic regression analysis the odds ratio (OR) for covering of iron and zinc EAR recommendations was calculated in relation to chosen confounders such as sex (men, women), age (continuous), physical activity (low, moderate) and education (incomplete primary, primary, professional, secondary, higher).

## RESULTS

Out of the 102 subjects aged 65-95 years (mean age = 78± 8.3 years), 43% were women and 57% men. Almost 61% were urban dwellers and 39% came from the countryside (Table 1). Those with a primary education constituted 45%, whilst those with secondary education 30%. Low levels of physical activity were self-assessed by 60% of subjects and 57% rated their health as being average. Over 70% suffered at least from one chronic condition, 33% took dietary supplements and 57% smoked cigarettes. Table 2 shows average enrgy values for the diets, actual intakes and % of energy derived by protein, fats and carbohydrates.

The daily average and usual intake of iron and zinc were higher in men than women, ranging from 5-27 mg for iron and 5-20 mg for zinc (Table 3). The EAR cut-point method demonstrated that 5% subjects consumed diets deficient in iron, being less than 6 mg; (Figure 1), thus indicating an inadequate level for their nutritional needs. The remaining 95% showed that iron intake was greater than the EAR in keeping with their average level requirement (probability >50%). In the case of zinc, 44% of subjects (34% women and 52% men) had intake values below the EAR; respectively 6.8 mg and 9.4 mg. Consumption of zinc above the EAR was noted in 56% cases, thereby being probably adequate for nutritional requirements.

Figure 2 shows the adequacy of iron and zinc intake assessed by z-scores. Because men and women have the same EAR values for iron, results from both genders were treated together. The highest probabilities of iron deficiencies were observed at levels of 0.55 and 0.75 corresponding to those observed in 2% and 1% of subjects respectively. Low probabilities (<0.5) of iron deficiencies were seen in 26% subjects, however around 71% had an insignificant risk (ie. zero probability) of this happening at all.

Table 1. Characteristics of examined group of elderly people

| Factor | Total n=102 % n | Women n=44 % n | Men n=58 % n | *Chi*² test p-value |
|---|---|---|---|---|
| **Place of living** | | | | |
| city | 61.0 | 54.5 | 65.5 | < 0.001 |
| village | 39.0 | 45.5 | 34.5 | |
| **Education** | | | | |
| none/incomplete primary | 8.0 | 9.1 | 6.9 | < 0.005 |
| primary | 45.0 | 61.4 | 32.8 | |
| professional | 7.0 | 2.3 | 10.3 | |
| secondary | 30.0 | 27.2 | 32.8 | |
| higher | 10.0 | 0.0 | 17.2 | |
| **Physical activity level** | | | | |
| small | 60.0 | 63.6 | 56.9 | NS** |
| moderate | 40.0 | 36.4 | 43.1 | |
| **Self-assessment of health status (on a scale of 0-10 points)** | | | | |
| very bad and bad (0-3 pts.) | 7.8 | 6.8 | 8.6 | NS** |
| medium (4-6 pts.) | 56.9 | 56.8 | 56.9 | |
| good or very good (7-10 pts.) | 35.3 | 36.4 | 34.5 | |
| **Current chronic diseases** | | | | |
| yes | 73.5 | 70.5 | 75.9 | NS** |
| no | 26.5 | 29.5 | 24.1 | |
| **Use of dietary supplements in the past week** | | | | |
| yes* | 33.3 | 27.3 | 37.9 | NS** |
| no | 66.7 | 72.7 | 62.1 | |
| **Smokers/Non-smokers** | | | | |
| yes | 56.8 | 36.4 | 72.4 | < 0.001 |
| no | 43.2 | 63.6 | 27.6 | |

* some respondents have used more than one supplement;
** NS – not significant, p>0.05;

Table 2. The average energy value and basic nutrients content in daily diets of the examined group of elderly people (usual intake)

| Nutrient | | Total n=102 | Women n=44 | Men n=58 |
|---|---|---|---|---|
| Energy (kcal) | average ± SD | 1601 ± 360 | 1476 ± 333* | 1695 ± 353* |
| | median | 1534 | 1296 | 1513 |
| | range | 749 - 2629 | 749 - 2521 | 991 - 2629 |
| Total protein (g) | average ± SD | 63.3 ± 15.2 | 55.9 ± 12.4* | 69.0 ± 14.7* |
| | median | 62.8 | 53.8 | 66.9 |
| | range | 28.0 - 100.6 | 28.0 - 75.9 | 30.9 - 100.6 |
| % energy from protein | | 15.9 ± 2.1 | 15.2 ± 1.9* | 16.4 ± 2.1* |
| Fats (g) | average ± SD | 58.5 ± 16.1 | 53.0 ± 14.6* | 62.7 ± 16.1* |
| | median | 56.2 | 50.3 | 61.2 |
| | range | 23.1 - 134.9 | 27.7 - 88.3 | 23.1 - 134.9 |
| % energy from fats | | 32.9 ± 5.1 | 32.4 ± 5.8 | 33.2 ± 4.6 |
| Carbohydrates (g) | average ± SD | 219.9 ± 54.8 | 207.6 ± 51.7* | 229.3 ± 55.6* |
| | median | 214.3 | 205.9 | 221.8 |
| | range | 89.1 - 385.7 | 89.1 - 355.6 | 143.4 - 385.7 |
| % energy from carbohydrates | | 55.0 ± 6.1 | 56.3 ± 6.4 | 54.0 ± 5.6 |

* statistically significant differences, p≤0.05 (t-test)

Table 3. The average content of iron and zinc in daily diets of the examined group of elderly people

| Element | | Total n=102 | Women n=44 | Men n=58 |
|---|---|---|---|---|
| Iron (mg) | average ± SD | 10.1 ± 3.3 | 8.9 ± 2.1* | 10.9 ± 3.8* |
| | median | 9.2 | 8.9 | 9.9 |
| | range | 4.8 - 26.6 | 4.8 - 13.5 | 5.3 - 26.6 |
| Zinc (mg) | average ± SD | 9.1 ± 3.0 | 8.3 ± 3.2 | 9.7 ± 2.7 |
| | median | 8.8 | 7.7 | 9.2 |
| | range | 4.1 - 20.4 | 4.3 - 19.6 | 4.1 - 20.4 |

* statistically significant differences, p≤0.05 (t-test)

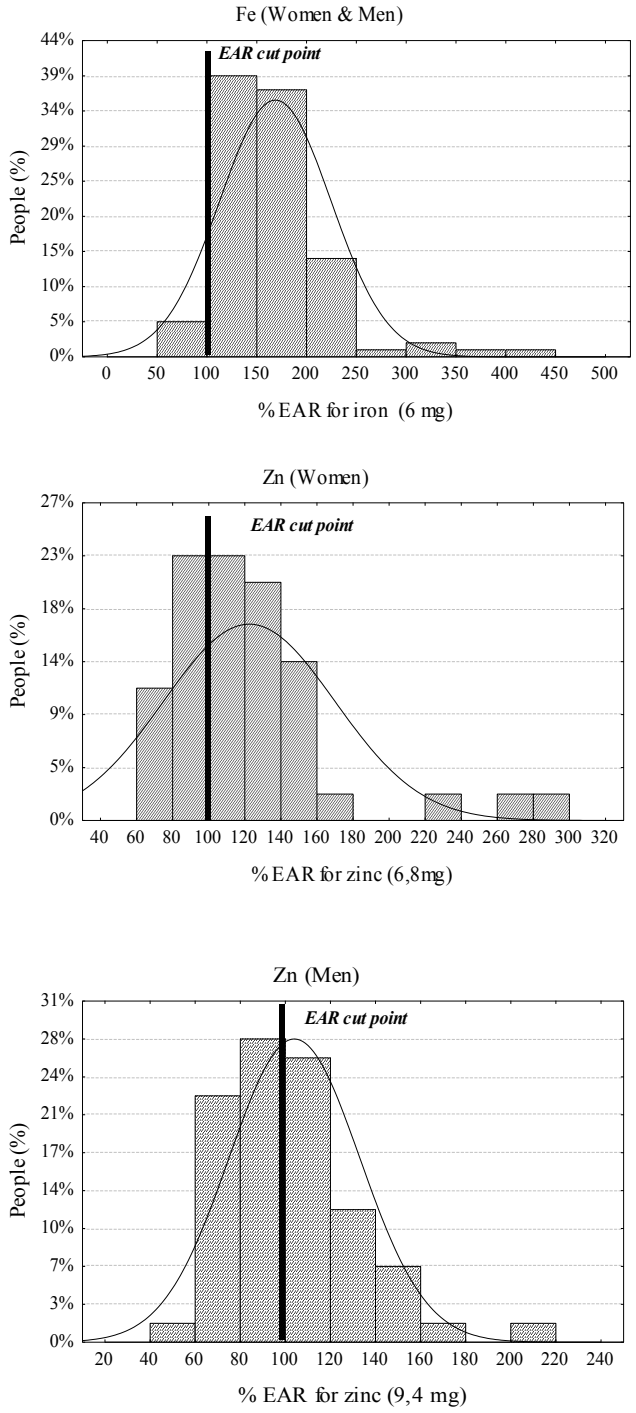


Figure 1. Distributions of the percent EAR for iron and zinc by daily diets of the examined elderly people

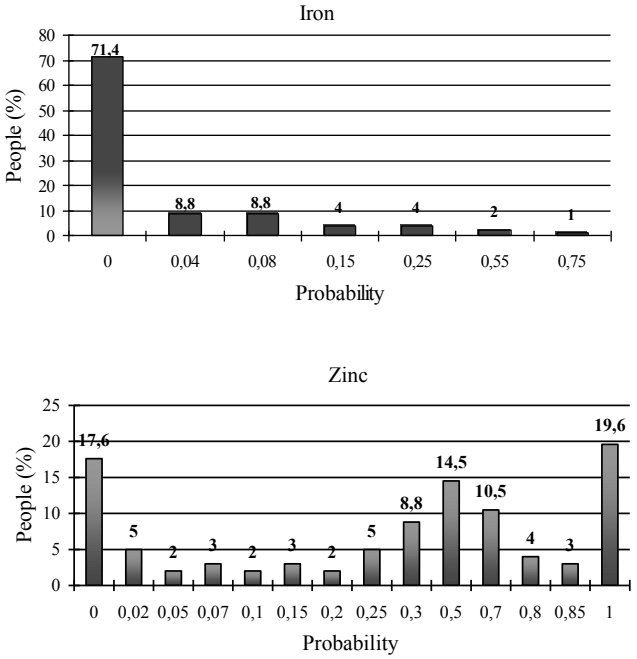


Figure 2. Probability of insufficient intake of iron and zinc among the elderly population

In the case of zinc, 20% of subjects had high probabilities of abnormal intakes (p=1.0) from their daily diets, whereas 17.5% had probabilities that ranged from p>0.5 to p<1.0 and 14.5% had p=0.5. About 30% subjects displayed low probability of abnormal dietary zinc intakes (p<0.5) and 17.6% had an insignificant risk (zero probability) meaning no exposure to any dietary deficiency of zinc. The data in Table 4 shows a high positive correlation (0.7≤ r<0.9) in the daily diets of the elderly between energy values, amounts of protein and fats with dietary levels of iron and zinc. A smaller but still high correlation (0.5≤ r<0.7) was observed between dietary levels of carbohydrates and those for iron and zinc; both correlations were statistically significant. As an example, Figure 3 shows the correlation between usual energy intakes with both iron and zinc. Besides, a high positive correlation (r=0.86) was observed between dietary iron with zinc. Logistic regression was used to determine whether various other factors, such as gender, age, physical activity or education, could affect abnormal iron or zinc intakes as well as looking at their inter-relationships (Table 5). The factors taken

Table 4. Correlation between the energy and macronutrient intake versus usual intake of iron and zinc

| Component | Iron | Zinc |
|---|---|---|
| Energy | 0.76* | 0.74* |
| Total protein | 0.76* | 0.79* |
| Fats | 0.71* | 0.69* |
| Carbohydrates | 0.61* | 0.58* |

* statistically significant correlations, p≤0.05 (*Spearman* test)

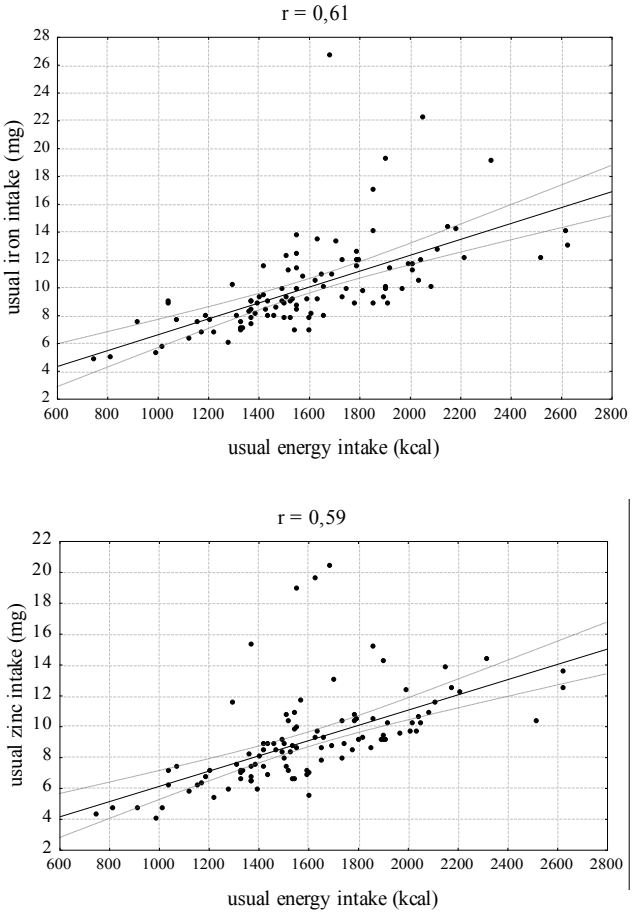


Figure 3. Correlation between the usual energy intake versus iron and zinc intake of the elderly people

Table 5. The risk of insufficient intake of iron and zinc in relation to selected factors of examined group of respondents (OR – odds ratio, CI – confidence interval)

| Factor | Iron | | | Zinc | | |
|---|---|---|---|---|---|---|
| | OR | % CI | p | OR | % CI | p |
| Sex | | | | | | |
| women | 1 | | 0.13 | 1 | | 0.08 |
| men | 0.17 | 0.018 - 1.67 | | 2.07 | 0.91- 4.69 | |
| Age* | 0.97 | 0.86 - 1.09 | 0.62 | 1.01 | 0.96 -1.06 | 0.60 |
| Physical activity | | | | | | |
| low | 1 | | 0.99 | 1 | | 0.97 |
| moderate | 0.99 | 0.12 - 7.87 | | 0.98 | 0.44 - 2.20 | |
| Education | | | | | | |
| primary | 1 | | | 1 | | |
| none/ incomplete primary** | | | | 0.33 | 0.06 - 1.90 | 0.20 |
| professional** | | | | 0.40 | 0.07 - 2.37 | 0.30 |
| secondary | 0.35 | 0.036-3.41 | 0.36 | 0.94 | 0.37 - 2.37 | 0.89 |
| higher** | | | | 0.43 | 0.10 - 1.93 | 0.26 |

* age was included in the model as a continuous variable (unit 1 year)

** too few cases in the group to determine the OR andn % CI for inadequate intake of iron

as reference were women, low physical activity persons and those with just basic education; odds ratio (OR) = 1. There were however in fact no statistically significant relationships detected. Gender was seen to have the most effect on abnormal iron intakes where an OR for men = 0.2 indicated a lower risk of iron deficiency compared to women (p=0.13). Conversely, a value of 2 for zinc (p=0.08 – tendency) indicated a higher risk of zinc deficiency in men than women. No effects could be discerned for the remaining factors.

## DISCUSSION

In the elderly appropriate nutrition is essential for good health and for being physically and mentally fit together with affecting the quality of life. This is especially important in the present situation in Poland with an increasingly aging population; the eldest groups significantly rising. Many studies however demonstrate that there are frequent nutritional shortcomings in this population group [10, 17]

The presented study has shown that diets are low in energy value for most subjects, which is a cause for concern and may lead to deficiencies of iron and zinc. This risk arises from the high positive correlations in amounts between various nutritional ingredients found in foodstuffs. Highly positive correlations were found between dietary energy intakes, amounts of basal nutritional ingredients and levels of iron and zinc in the elderly. Thus any decreases in either the dietary energy value or the nutritional ingredients will lead to falls in iron and zinc levels.

Results did not show any substantial risks in iron intakes, the average being 9 mg/day for women and 11 mg/day for men. These values were higher than the EAR set at 6 mg for both genders. Only 5% of subjects studied were below this EAR, the rest, by a large majority (95%), most likely have adequate iron in their diets and thus no iron deficiency. Similar dietary levels of iron were recorded in a previous study from 1999 [24] covering the Warsaw region, with levels of iron in men at 10.4 mg and 7.7 mg in women. An even earlier study from 1993, undertaken as part of the SENECA project in the Marki suburbs of Warsaw, demonstrated a median of 16.4 mg iron in the diets of elderly men, with 10% subjects having dietary iron levels below 10.1 mg. In the case of women, 10% had intakes of iron less than 6.4 mg, however the median value in this group was 13.1 mg [2]. Slightly smaller daily intakes of iron were however observed in a study by *Wądołowska* et al. [23], with values of 7 mg for women and 10 mg for men. Studies conducted abroad, likewise indicated that dietary iron intakes amongst the elderly are adequate. For example, dietary iron

levels in the elderly reported from Australian [25] and Brazilian [8] work were consistent to those presented. Higher levels of the aforementioned were however seen in Spanish and USA studies. For example the work of *Lopez-Contreras* et al. [13], demonstrated 14 mg and 12 mg levels respectively for men and women, whilst studies from California and Oklahoma showed slightly higher dietary iron levels of 17 mg for men and 13 mg for women. Another analogous USA investigation by *Ma* and *Betts* [14] on n=2974 elderly subjects, showed daily dietary iron to be 16 mg for men and 12 mg for women. Even higher levels were observed in a USA study on Champaign City inhabitants, with average iron levels of 18 mg/day in a diet that included taking supplements [22]. Some of the aforementioned studies, namely [3, 22, 25], demonstrated that over 90% subjects were not at risk from iron uptake deficiency, whereas the current study showed this figure to be 71% for iron intake. In addition, out of those surveyed, over 25% had minimal risk of iron deficiency and only 3% could really be considered at high risk.

The daily average zinc consumption was in this study found to be 9.7 mg for men and 8.3 mg for women, which are higher than the corresponding EAR values of 9.4 mg and 6.8 mg. In fact, this study demonstrated that deficiencies in dietary zinc intake for the elderly were much more frequent than those for iron; nearly half the elderly subjects, (52% men, 34% women), consumed zinc below the EAR value. The remainder showed zinc intakes above the EAR which therefore, likely met their needs.

Other Polish studies conducted on the elderly have, nevertheless, shown smaller or similar levels of dietary zinc intakes. For example, *Stawarska* et al. [20] demonstrated that daily dietary zinc consumption in senior members of various associations were 9.6 mg for men and almost 7 mg for women. Even lower levels were found in a study in Wroclaw, carried out on the elderly, where such daily zinc levels were 7 mg for men and 8 mg for women, *Wyka* et al. [26]. In slight contrast, a Warsaw study [24] found higher zinc intake levels from the diet: 10 mg for men and 7.6 mg for women. A further and similar study by *Kałuża* et al. [12] conducted on elderly subjects in the Warsaw region, also took into consideration the zinc content of the water drunk, which resulted in recording zinc levels of 11.2 mg in men and 8.9 mg in women. Thus it is seen, that without accounting for the zinc content in water, dietary zinc level will inevitably be underestimated.

Investigations from abroad also show lower levels of dietary zinc amongst the elderly. In Australia, women on average daily consume 6.5 mg zinc and men 9.0 mg. Another Brazilian study [8] by *Correa* et al. demonstrated even smaller average levels of zinc consumption at 4.5 mg daily. However compared to the present study, higher levels of zinc intakes were observed by *Andriollo-Sanchez* et al. [4] for subjects aged above 70 years resident in France and Italy with average dietary zinc consumption of 10.5 mg for women and 12 mg for men. The aforementioned USA study, *Wardwell* et al. [22], demonstrated that for zinc, the average dietary consumption per day, including taking supplements, was as high as 21 mg. When making comparisons with standard values, the Australian study showed that 91% of male subjects and 46% females consumed daily zinc at levels below the EAR (i.e. 12 mg for men and 6.5 mg for women [25]. The *Wadwell* et al. study [22] from the USA, demonstrated that those elderly people with deficiencies in zinc uptake below the mean, constituted 7% women and 26% men.

The presented study shows the likelihood that only 18% subjects have adequate dietary zinc consumption relative to the nutritionally required levels, i.e. these had no risk of deficiency. It was found that approximately 30% of subjects had low probability of such a deficiency occurring, compared to the general mean seen in this population group at 14%. The remaining subjects were, to a high degree, vulnerable to zinc deficiency, of whom nearly 20% showed a 100% probability of an inappropriate intake from the daily diet. These results thus show that zinc is a crucial element of the elderly diet. An insufficient zinc consumption, coupled with nutritional deficiencies in the diet of constituents such as carbohydrates, vitamins B1, B6, PP, potassium, phosphorus, magnesium and copper significantly increase the risk of premature death [11].

With the exception of gender, the study also showed, a negligible influence of the other aforementioned population factors, when assessed statistically, on the intakes of iron or zinc. In fact, men showed an almost twofold less risk of having an abnormal iron intake compared to women. Conversely the reverse was true for zinc, where the risk of women having an intake was twice less than that for men. A study by *Wierzbicka* et al. [24] also demonstrated an effect of gender as illustrated by men's diets containing more iron and zinc than women. In addition, women living in cities consumed more dietary iron and zinc compared to those living in rural or suburban areas. The high correlation observed between dietary iron and zinc levels indicates the need for increasing the amounts of zinc-containing foods in a given diet without necessarily altering iron levels.

## CONCLUSIONS

1. Too low energy value of the observed diets in the elderly, aged 65 years and above, constitutes a risk of having dietary iron and zinc deficiencies.
2. Due to the small risk of dietary iron deficiency, there

is no need to increase its intake among the studied group of elderly.
3. Dietary zinc intake should however be increased (without changing iron intake) through a greater consumption of milk, dairy products, wheat bran, pumpkin or sunflower seeds, beans, lentils and nuts.
4. To improve dietary patterns of the elderly and avoid nutritional deficiencies there is a need to recommend consumption of products with high nutritional density. If it is not possible foodstuffs enriched with minerals and vitamins, or appropriate dietary supplements should also be recommended.

**Aknowledgements**

*This study was supported and implemented under publicly-funded project no. PBZ-MEIN-9/2/2006 "Medical, psychological, sociological and economic aspects of aging in Poland (PolSenior)".*

## REFERENCES

1. *Amarantos E., Martinez A., Dwyer J.*: Nutrition and quality of life in older adults. J Geront 2001;56:54-64.
2. *Amorim-Cruz J.A., Moreiras O., Brzozowska A*. and SENECA investigators: Longitudinal changes in the intake of vitamins and minerals of elderly Europeans. Eur J Clin Nutr 1996;50:77-85.
3. *Anderson J.J.B., Suchindran C.M., Roggenkamp K.J.:* Micronutrient intakes in two US populations of older adults: Lipid Research Clinics Program Prevalence Study findings. J Nutr 2009;13:595-600.
4. *Andriollo-Sanchez M., Hininger-Favier I., Meunier N., Toti E., Zaccaria M., Brandolini-Bunlon M., Polito A., O'Connor J.M., Ferry M., Coudray C., Roussel A.M.*: Zinc intake and status in middle-aged and older European subjects: the ZENITH study. Eur J Clin Nutr 2005;59(2):37-41.
5. *Błędowski P., Mossakowska M., Chudek J., Grodzicki T., Milewicz Wieczorowska-Tobis K., Więcek A., Szybalska A., A., Bartoszek A., Dąbrowski A., Zdrojewski T.*: Medical, psychological and socioeconomic aspects of aging in Poland. Assumption and objectives of the PolSenior project. Exp Gerontol 2011;28:1003-1009.
6. *Carriquiry A.L.*: Estimation of usual intake distributions of nutrients and foods. J Nutr 2003;133:601-608.
7. *Cockell A., Miller D.C., Lowell H.*: Application of the Dietary Reference Intakes in developing a recommendation for pregnancy iron supplements in Canada. Am J Clin Nutr 2009;90:1023-8.
8. *Correa B., Leandro-Merhi V.A., Pagotto Fogaca K., Marques de Oliveira M.R.*: Caregiver´s education level, not income, as determining factor of dietary intake and nutritional status of individuals cared for at home. J Nutr 2009;13:609-614.
9. Food and Nutrition Board, Institute of Medicine. Dietary Reference Intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium and zinc. National Academy Press, Washington, 2001.
10. *Jarosz M., Bułhak-Jachymczyk B*. (red.): Normy żywienia człowieka. Podstawy prewencji otyłości i chorób niezakaźnych. Wydawnictwo Lekarskie PZWL, Warszawa 2008.
11. *Kałuża J., Dołowa J., Roszkowski W., Brzozowska A.*: Przeżywalność a spożycie wybranych składników pokarmowych przez mężczyzn w wieku podeszłym. Rocz Panstw Zakl Hig 2005;56:361-370.
12. *Kałuża J., Zyśk A., Brzozowska A.*: Udział grup produktów i wody pitnej w spożyciu wybranych składników mineralnych przez osoby starsze. Rocz Panstw Zakl Hig 2002;55:407-417.
13. *Lopez-Contreras M.J., Zamora-Portero S., Lopez M.A., Marin J.F., Zamora S., Perez-Llamas F.*: Dietary intake and iron status of institutionalized elderly people: relationship with different factors. J Nutr Health Aging 2010;14(10):816-821.
14. *Ma J., Betts N.M.*: Zinc and copper intakes and their major food sources for older adults in the 1994–96 continuing survey of food intakes by individuals (CSFII). J Nutr 2000;130:2838-2843.
15. *Maret W., Sandstead H.H.*: Zinc requirements and the risks and benefits of zinc supplementation. J Trace Elem Med Biol 2006;20:3-18.
16. *Otten J.J., Hellwig J.P., Meyers L.D.*: Dietary Reference Intakes. The Essential Guide to Nutrient Requirements. The National Academies Press, Washington, 2010.
17. *Pietruszka B., Kołłajtis-Dołowy A., Szulc K., Kałuża J., Broczek K., Pawlińska-Chmara R., Mossakowska M.*: Characteristics of nutrition among centenarians living in Warsaw. Pol J Food Nutr Sci 2006;15/56(SI 2):111-115.
18. *Prasad A.S.*: Clinical, immunological, anti-inflammatory and antioxidant roles of zinc. Exper Gerontol 2008;43:370-377.
19. Safe upper levels for vitamins and minerals. Expert Group on Vitamins and Minerals, 2003:275-286, http://www.forumzdrowia.pl/id,568,art,548,ptitle,zywienie-osob-starszych.htm
20. *Stawarska A., Tokarz A., Kolczewska M.*: Ocena ilościowa składników mineralnych i witamin w dietach ludzi starszych zrzeszonych w wybranych warszawskich stowarzyszeniach społecznych. Cz. III. Bromatol Chem Toksykol 2009;42(2):117-122.
21. *Szponar L., Wolnicka K., Rychlik E.*: Photographs of food products and meals. Institute of Food and Nutrition (IŻŻ), Warsaw 2000 ( in Polish).
22. *Wardwell L., Chapman-Novakofski K., Herrel S., Woods J.*: Nutrient intake and immune function of elderly subjects. J Am Diet Assoc 2008;108:2005-2012.
23. *Wądołowska L., Waluś A., Cichon R., Słowińska M. A.*: Piramida zdrowego żywienia w profilaktyce żywieniowej chorób układu krążenia – realizacja zaleceń w racjach pokarmowych osób w wieku podeszłym. Czynn Ryz 2003;38/39(4/02-1/03):49-57;
24. *Wierzbicka E., Brzozowska A., Roszkowski W.*: Energy and nutrients intake of elderly people living in the Warsaw Region, Poland. J Nutr Health Aging 2001;5(4):248-252.

25. *Woods J.L., Walker K.Z., Iuliano-Burns S., Strauss B.J.*: Malnutrition on the menu: nutritional status of institutionalised elderly Australians in low-level care. J Nutr Health Aging 2009;13(8):693-698.
26. *Wyka J., Biernat J., Kiedik D.*: Nutritional determination of the health status in Polish elderly people from an urban environment. J Nutr Health Aging 2010;1:67-71.

Received: 17.10.2012
Accepted: 04.03.2013