

RESEARCH ARTICLE

The correlation of zinc serum levels and zinc intake with taste disorders in elderly patients at Babatan Public Health Center Bandung

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ABSTRACT

Taste disorders, which can be caused by various factors, including deficiency of zinc levels in the body and lack of zinc, generally occur in the elderly. The aim of the study was to analyze the correlation between zinc serum levels and zinc intake, as well as the correlation between salivary volume, hypertension, and smoking with taste disorders in the elderly. This was analytical observational research with a cross-sectional method, which was conducted on 100 elderly patients, at Babatan Health Community Center, Bandung, Indonesia. The sampling was conducted through the following: interview about systemic disease history, drugs taken, and smoking habits; examination of oral cavity conditions; nutrition intake interviews; taste tests tests; and zinc serum measurement using the atomic absorption spectrometry. The data were obtained statistically. Among these one hundred elderly patients, 79 had low zinc serum levels and 94 had inadequate zinc intake. The average zinc serum in the elderly patients with taste disorders was 40.1 µg/dl, whereas those without taste disorders was 72.4 µg/dl, with a p value of <0.001. The average zinc intake in the elderly patients with taste disorders was 3.4, whereas in those without taste disorders was 6.0, with a p value of <0.027. Smoking correlated with taste disorders, while salivary volume and hypertension had no a correlation with taste disorders. There was correlation between zinc serum levels and zinc intake on taste disorders in the elderly patients. Smoking had a relationship with taste disorders in the elderly patients, whereas salivary volume and hypertension had no correlation with taste disorders in the elderly patients.

Keywords: elderly; taste disorders; zinc nutrition; zinc serum

INTRODUCTION

Improved health enhances the quality of life and public health, which will also impact the improvement of living standards and life expectancy. This can be seen from the increasing population of healthy, active, and productive elderly people from year to year. Elderly is defined as people aged 60 years or over, whose physiological function has decreased due to aging. Based on WHO data, in the mid-20th century, many people lived to old age, therefore increasing the elderly population, by 2.5%. In 2050, the elderly population is estimated to reach 2 billion people.¹⁻³

Aging is a physiological and progressive process characterized by degenerative changes, both in the structural and in the functional capacity of organs and tissues, resulting in some setbacks and weaknesses. The ability of tissues to regenerate

and maintain their normal structure and function gradually decreases, making them unable to withstand diseases and repair damages suffered. Degenerative changes affect the nutritional needs of the elderly, and inappropriate nutritional intake will cause problems to them, which will also impact their health status. Adequate nutrition is obtained from adequate nutritional intake. Nutrition is also very important for an individual's oral health; nutrition affects the integrity and function of teeth, supports the structure of the mouth, and has a direct effect on general health.^{1,4,5}

Lack of one or several micronutrients can result in functional consequences on health, including oral tissue. One of the micronutrients that is needed for the health of oral cavity tissue is zinc; which plays an important role both in tissue growth and maintenance, and in cells with high turnover,

such as in taste buds and taste sensitivity.^{6,7} Zinc deficiency is often found in the elderly; the elderly have zinc intake that is below 50% of the recommended daily intake. Zinc deficiency in the elderly is an important factor that causes oral cavity disorders, one of which is taste disorders.⁸⁻¹⁰

Taste is a function of the sense of taste in the mouth. Taste is obtained from the taste sensation produced by the papillae on the tongue, these are fungiform, foliate, and circumvallate papillae. Taste molecules are transported by saliva and come in contact with the taste buds of the microvilli on the tongue. The papillae on the tongue experience very rapid turnover; in normal people, it takes around 10-15 days, whereas it is slower in the older people. In general, there are four basic flavors: sweet, salty, sour, and bitter. Taste disorders can be influenced by aging, lack of nutrition, volume of saliva, drugs, systemic diseases (hypertension, diabetes mellitus), alcohol, or smoking.¹¹⁻¹³

It has been reported that taste disorders are common in the elderly. Therefore, the prevalence of taste disorders is higher in the elderly than at a young age. Taste disorders are often underestimated, but they can adversely affect the health of the elderly. Taste disorders can cause appetite loss, changes in food choices, anorexia, weight loss and malnutrition, consequently exacerbating chronic illness, and increasing morbidity and mortality.¹⁴⁻¹⁶ This study aimed to analyze the correlation of zinc serum levels and zinc intake with taste disorders in elderly patients.

MATERIALS AND METHODS

This was analytical observational research with a cross-sectional method. The study was conducted on 100 elderly patients (35 male and 65 female), who came to the elderly clinic of Babatan Health Center in Bandung City, with and without taste disorders. The ethical clearance was obtained from the ethics committee of Dr. Hasan Sadikin Hospital Bandung (1231/UN6.KEP/EC/2019).

The inclusion criteria used in this study were as follows: elderly (aged ≥ 60 years),

willing to be the subject of the research, willing to sign an informed consent, having /no having taste disorders, suffering from hypertension without other systemic diseases, and having no cognitive disorders according to the Mini Mental State Examination (MMSE) with a value of ≥ 24 . The exclusion criteria were patients who were unable to open their mouths, elderly with systemic diseases (e.g., decreased immune system, liver disorders, gastrointestinal disorders, kidney disorders, diabetes mellitus), and patients with nerve injuries.

The data were collected by a single-blind method. The collected data included the general description of the patients; namely age, sex, occupation, smoking habits, systemic conditions, salivary volume, routine medications, oral conditions, and assessment of cognitive functions using a MMSE questionnaire with a value of ≥ 24 . Zinc intake was assessed using the food frequency questionnaire and stimulation threshold measurement using four taste solutions with two concentrations (sweet: sucrose, 0.01 M and 0.1 M; saltiness: sodium chloride, 0.01 M and 0.1 M; sour: citric acid, 0,00032 M and 0.0032 M; and bitter: quinine, 0.000008 M and 0.000008 M). Zinc serum levels were measured by taking blood in the upper arm veins by ± 3 cc and analyzed using atomic absorption spectrometry.

For the statistical analysis of the data, SPSS for windows version 25.0 was used. Fisher's exact test was also used to examine the relationship of zinc serum levels and zinc intake with taste disorders, p value of ≤ 0.05 was considered significant.

RESULTS

The results showed that 79 respondents had zinc deficiency and 94 had low zinc intake. The normal zinc serum levels in adults are 70 $\mu\text{g/dL}$ for men and 66 $\mu\text{g/dL}$ for women. The normal zinc intake levels based on regulation of the Minister of Health of the Republic of Indonesia No. 28 of 2018 and dietary reference intake (DRI) are 8 mg / day for women and 11 mg/day for men.¹⁷⁻¹⁹

Table 1. Research characteristics

| No | Variable | With taste disorders | Without taste disorders | n |
|------------|-----------------|----------------------|-------------------------|----|
| Gender | | | | |
| 1 | Male | 25 | 11 | 35 |
| | Female | 25 | 39 | 65 |
| Age (year) | | | | |
| 2 | 60–69 years old | 37 | 38 | 75 |
| | 70–79 years old | 9 | 11 | 20 |
| | >80 years old | 5 | - | 5 |
| MMSE | | | | |
| 3 | Median (range) | 26 (24–29) | 26 (24–30) | |
| | Hypertension | 26 | 19 | 45 |
| 4 | Smoking habits | 24 | 8 | 32 |
| Profession | | | | |
| 6 | Employed | 20 | 10 | 30 |
| | Unemployed | 30 | 40 | 70 |

Table 2. Zinc serum levels and zinc intake in elderly patients

| Variable | Taste disorders | |
|-------------|-----------------|-------------|
| | Yes (n = 50) | No (n = 50) |
| Zinc serum | | |
| Low | 50 (100.0%) | 29 (58.0%) |
| Normal | 0 (0.0 %) | 21 (42.0%) |
| Zinc intake | | |
| Inadequate | 50 (100.0 %) | 44 (88.0%) |
| Adequate | 0 (0.0%) | 6 (12.0%) |

Table 3. Mean, standard deviation (SD), range, p value of zinc serum levels and zinc intake in elderly patients

| Variable | Taste disorders | | p |
|--------------------|-----------------|-------------|--------|
| | Yes (n = 50) | No (n = 50) | |
| Zinc serum (µg/dL) | | | |
| Mean (SD) | 40.1 (9.7) | 72.4 (25.4) | <0.001 |
| Median | 41.4 | 63,6 | |
| Range | 12.5–55.3 | 46.2–162.6 | |
| Zinc intake (mg) | | | |
| Mean (SD) | 3.4 (0.9) | 6.0 (1.6) | <0.027 |
| Median | 3.6 | 5.6 | |
| Range | 1.8–5.8 | 3.3–12.5 | |

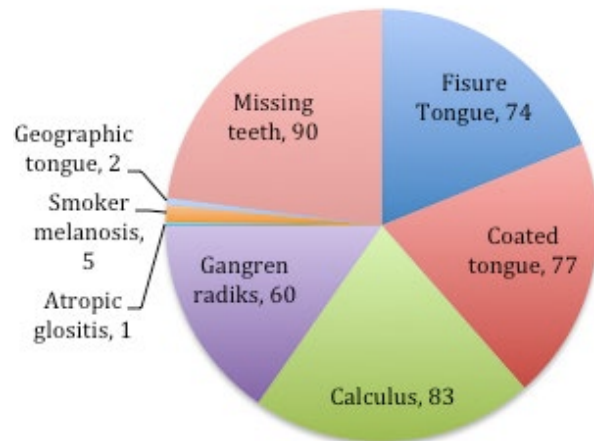


Figure 1. Oral cavity condition

Table 4. Correlation of confounding variables with taste disorders in elderly patients

| Variable | Taste disorders | | p |
|-----------------|-----------------|-------------|-------|
| | Yes (n = 50) | No (n = 50) | |
| Salivary volume | | | |
| Hyposaliva | 5 (10.0) | 0 (0.0) | 0.093 |
| Normal | 45 (90.0) | 50 (100.0) | |
| Hypertension | | | |
| Yes | 27 (54.0) | 18 (36.0) | 0.070 |
| No | 23 (46.0) | 32 (64.0) | |
| Smoking | | | |
| Yes | 24 (48.0) | 8 (16.0) | 0.001 |
| No | 26 (52.0) | 42 (84.0) | |

In this study, the results showed that there was a significant relation between zinc serum levels and zinc intake, and taste disorders in the elderly patients. In this study, the results of the analysis showed that smoking had a significant relationship with taste disorders, whereas hypertension and salivary volume had no significant relation with taste disorders.

DISCUSSION

Based on the research conducted on 100 elderly research subjects, it was found that out of the 50 people who had a taste disorder, all (100.0%) had low zinc serum and low zinc intake, whereas among those who did not have any taste disorder, 58.0% had low zinc serum and 88.0% had inadequate zinc intake. The zinc serum levels and zinc intake in the elderly patients who had taste disorders were lower than those in the elderly patients without any taste disorders, with a *p* value of <0.05.

In the elderly, both women and men are at a high risk for low zinc serum levels.^{10,19} Zinc deficiency experienced by the research subjects may be caused by several factors, namely aging (intestinal malabsorption, changes in cellular zinc homeostasis), lack of intake of foods containing zinc, high consumption of zinc absorption inhibitors, and high consumption of vegetables containing phytic acid and dietary fiber. Phytate is one component that can inhibit the absorption of zinc in the body. This is in line with Cabrera's research stating that zinc deficiency in the elderly is due to the fact that elderly consume vegetables and fibrous foods that contain high amount of phytate, which then limits zinc absorption in the intestine and also causes intestinal malabsorption and changes in intracellular zinc homeostasis, lowering the intracellular zinc content.²⁰⁻²²

The low zinc intake in the research subjects was due to the low consumption of food sources of zinc. The elderly are at risk of suboptimal zinc intake (less than the recommended zinc adequacy value) due to physiological, psychological and economic factors.^{21,23} The low consumption of food sources of zinc can also be influenced by several

other factors, including decreased appetite, changes in diet and health status due to patient's oral cavity (tooth loss), and low income which causes low purchasing power.^{22,24-26} In this study, 90 research subjects had lost their teeth either partially or completely and 60 people had residual tooth root, which greatly affected their chewing power, as Ozeki said that the decline in taste in old age is caused by the inability to fully chew food.

Foods that are high in zinc are generally found in animal food sources, such as beef, chicken, milk, and shellfish which are quite expensive.^{27,28} Low income populations tend to consume more plant-based foods which are cheaper than animal sources. In this study, 70% of the research subject unemployed, while 30% of them were employed, with jobs including: traders (20 people), health center employees (1 person), teacher (1 person), salesperson (1 person), self-employed (4 people), parking attendant (1 person), carpenter (1 person), and household assistant (1 person). Age, limitations of the elderly, and the environment in which they lived were likely to influence the elderly to get a job and keep working, thus affecting their food purchasing power.

The most common cause of taste disorders is zinc deficiency, which is common in the elderly.^{29,30} Taste buds are known to contain various enzymes that contain zinc. Zinc is a vital element in the repair and maintenance of taste buds; zinc helps in the synthesis of gustin protein which is related to the growth of taste buds. Zinc deficiency can inhibit cell division, growth, and tissue repair and decreases the rate of proliferation and regeneration of taste buds, causing a decrease in the number of papillae, size, and structure of the taste cells as well as a reduction in microvilli in taste buds, which in turn impairs the function of taste buds and decreases taste sensitivity. Taste disorders due to zinc deficiency have been widely reported over the past 40 years.^{19,26,29,31}

Taste disorders in the elderly are due to lack of zinc intake. Aging of taste buds decreases taste sensitivity.³² Taste disorders in the elderly are generally only partial and the degree of the disorders depends on the chemical structure of the

taste buds. Some of the factors that affect taste are the number and of papillae and taste buds, salivary volume, and the structure of papillae and taste buds. Taste buds have a limited life span; after a few days, they will die and will be replaced with new ones within an average of 10-15 days. Constant renewal allows taste sensitivity to remain good, but when there are problems such as reduced nutrition, taste disorders may occur.^{2,33,34}

Smoking is a habit that can cause taste disorders. Cigarettes contain dangerous, toxic and carcinogenic substances. Smoking can cause health problems and affect the oral cavity. The effect of smoking on the oral cavity varies depending on gender, lifestyle, diet, ways of smoking and duration of smoking. The heat generated when smoking can damage and disrupt taste buds. This condition is in line with previous studies stating that the more cigarettes smoked, the lower the number of papillae.^{35,36} The results of this study indicated that 32 research subjects had a smoking habit and 24 of them had taste disorders.

The limitations of this study include involved small number of samples which leading to high respondent subjectivity. There is no interventions to the research subjects, making it impossible to compare the zinc serum levels before and after supplementation.

CONCLUSION

There is a relationship between zinc serum levels and zinc intake with taste disorders in elderly patients. In elderly patients with taste disorders, the average zinc serum level and zinc intake are lower than those without taste disorders. Smoking is correlated with taste disorders in elderly patients, whereas salivary volume and hypertension have no relationship with taste disorders in elderly patients.

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CONFLICT OF INTEREST

The authors declares that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

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