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Sweet Taste Sensitivity and Its association with Serum Zinc Levels in Women with Premenstrual Syndrome

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Abstract

Approximately 75-80% of women at reproductive age had Premenstrual Syndrome (PMS). The PMS symptom is the desire to eat sweet foods. Zinc deficiency is often found in women with PMS. Theoretically, there is an imbalance of estrogen and progesterone hormone at PMS lead to unsensitivity sweet taste as a result of decreased zinc intake This study want to know the correlations between serum zinc levels and sweet taste sensitivity in PMS women.

This study was an experimental study, the sample used simple random sampling consisted 7 peoples who were selected based on criteria. The sample devided into two groups: one group of women with PMS and one group women with no experience of PMS. Research was done in luteal phase of the menstrual cycle.

There was no differences of serum zinc levels between the groups p=0.362 (p> 0.05); there was no differences in the sensitivity of sweet taste between the groups p=0,079 (p> 0.05); there was no correlations between sweet taste sensitivity and serum zinc levels p=0,340 (p> 0.05). There were no differences and correlation between sweet taste sensitivity and serum zinc levels in PMS.

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Introduction

Approximately 75-80% of women on reproductive age reported having premenstrual syndrome (PMS). Based on the report by the World Health Organization (WHO), the prevalence of PMS is higher in Asian countries compared to Western countries. Research conducted by the Teenage Health Service (PKRR) under the auspices of WHO in 2005 stated that 38.45% Indonesian women had issues on menstrual disorders, it was then becoming a major problem[1].

Premenstrual syndrome (PMS) is a condition of hormonal changes in the menstrual cycle with typical symptoms that occur routinely. It is characterized by physical and physiological symptoms.[1] Premenstrual syndrome is generally characterized by the appearance of symptoms such as depression, irritability, mood changes, anxiety, change in appetite, and abdominal pain. These symptoms appear in the luteal phase of the menstrual cycle and disappear soon after the menstruation begins.[2]

Changes in nutrient intake during menstruation associated with hormonal fluctuations. Selection of food may be affected by changes in taste perception in certain phases of the menstrual cycle. One of the symptoms of PMS is the desire to eat sweet foods. In the luteal phase, there is change in the quality of carbohydrate intake, with predominant intake of simple carbohydrates from sweets and sugars. It is believed that women increase carbohydrate ingestion days prior to menstruation due to an unconscious search for production of neurotransmitters related to mood improvement, since carbohydrates, especially simple carbohydrates, increase the tryptophan availability, precursor of serotonin in the brain.[3]

Taste perception is influenced by the sense organ of taste. The sensation of taste arises due to the detection of chemicals substance by specific receptors in the end of

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taste buds on the tongue and soft palate. Hormonal state can affect a person's perception of taste. Women on menstrual period have a different perceptions of taste compared to woman who is not in her period.[4]

Premenstrual syndrome is more frequent occur in women who are sensitive to hormonal changes in the menstrual cycle. The imbalance between estrogen and progesterone becomes a major risk factor of premenstrual syndrome.[5] Increased levels of estrogen are closely related to elevated levels of copper. It can lead to decreased levels of zinc because copper is an antagonist of zinc.[6] Zinc plays an important role in the taste perception. Zinc deficiency is often found in women with premenstrual syndrome and may affect the taste sensitivity. Zinc is important in taste function because of its influence in carbonic anhydrase VI (CA VI) and regeneration of taste buds.[7] Another study stated that zinc deficiency results in a decrease in CA II mRNA and protein expression as well as significantly lowering serum zinc concentrations.[8]

The aim of this study to identify, analyze, and prove that there is a relationship between sweet taste sensitivity due to serum zinc levels in women with PMS.

Materials and methods

This was an experimental study that was conducted at biochemistry laboratory, Faculty of Medicine Airlangga University and Balai Besar Laboratorium Kesehatan (BBLK) Surabaya 118/KKEPK.FKG/VII/2016. Subjects were students of Faculty of Dental Medicine Airlangga University, aged 18-24 years. The recruitment of subjects was based on simple random sampling method. Subjects were in the luteal phase of the menstrual cycle. Subject interviewed using questionnaire and divided based on criteria of the sample; women with PMS and without PMS. Homogenizaton of respondent's characteristics was done using quistionnaire. The question posed in the questionnaire regarding respondent's characteristics include age, weight, height, marital status, exercise, consumption of food, consumption of drugs, food supplements or certain minerals, smoking habit, and certain systemic disorders. These characteristics can be useful in considering factors that might influence the results.

The study was conducted at 08.00 o'clock a.m and the samples were collected after 10 hours overnight fasting period. Materials used to measure serum zinc levels samples were 5 cc syringe, vacutainer, plaster, centrifuge, serum sample cups, Atomic Absorption Spectrophotometry (AAS), and alcohol swab. Blood 5 cc was collected from cubital vein. Furthermore, the centrifuge (Sorvall™ Legend™ XT/XF Centrifuge Series, Thermo Fisher Scientific, Waltham, MA USA) with the power of 4000 RPM for 15 minutes was done in order to get 2 cc of blood serum to measure zinc levels using Atomic Absorption Spectrophotometry (AAS) (GD-4530F, Chongqing, China).

This study was using sucrose solution (Sigma-Aldrich®, St. Louis, USA). The subjects were instructed to taste the sucrose solution in the tip of tongue using cotton buds with the lowest to higher concentration with the following concentrations; 0,01 M; 0,013 M; 0,017 M; 0,022 M; 0,029 M; 0,038 M; 0,049 M; 0,064 M until the subjects could taste the sweetness. The concentration of sucrose solution that can be felt assessed with the index scoring from 0 to 8; 0.01 M = 8; 0,013 M = 7; 0,017 M = 6; 0.022 M = 5; 0,029 M = 4; 0,038 M = 3; 0,049 M = 2; 0,064 M = 1; could not taste sweet in any concentration = 0. Sweet taste sensitivity were analyzed using Mann-Whitney Test and serum zinc levels were analyzed using Independent t-test. As for the analysis of correlation between serum zinc levels and the sweet taste sensitivity in women with PMS, Spearman correlation test was used.

Results

The sweet sensitivity and zinc serum level mean rank between PMS and non PMS can be seen at table 1.

Group	Sweet Sensitivity (mean rank)	Zinc Serum Level (mean rank ±Std).
PMS	5,57	191,48±62,58
Non-PMS	9,43	162,95±49,45

Table 1. Mean rank of sweet sensitivity and zinc serum level in PMS and non PMS Women (n=7).

Data analysis in serum zinc levels was done using Kolmogrov Smirnov for normality test, PMS group value of 0,581(p> 0,05) and non PMS group value of 0,340 (p>0,05). Data analysis in sweet taste sensitivity using Oneway Anova for descriptive and homogeneity test value

of 0.256 (p>0,05). Independent t test, showed that there was no significant differences between groups tested shown with significance value of 0.362 (p> 0.05), there is no differences in serum zinc levels between the group tested.

Data analysis in sweet taste sensitivity using mann-whitney test to know significant different between the group tested, showed that there was no significant differences between groups tested with significance value of 0.079 (p>0,05). Data analysis using spearman correlations showed value of -0,276, which indicated that the correlation was weak and significance value of 0.340 (p>0,05), which indicated that there was no significant correlations between groups tested. This result considered as there is no correlations between sweet taste sensitivity and serum zinc levels.

Discussion

The results of the study for sweet taste sensitivity in each sample group showed no significant difference between the groups tested. Although the descriptive analysis results indicate that there was a decrease in mean rank value in the PMS group, it can not be a proof to statistically indicate the difference between the groups tested.

There are several factors that can affect the sensitivity of sense taste organ, including age, food temperature, smoking habits, and oral hygiene. Age affects the sensitivity of taste receptors that generally decreases at the age of 50. Therefore, the age of the subjects used in the study was in productive age of 18-24 years. Hormonal state can also affect a person's perception of taste. Women on menstrual period have a different perceptions of taste compared to woman who is not in her period[5]. Recent studies found that women with PMS has a high vulnerability to the hormonal changes rhythm during the menstrual cycle[9]. Initial presumption of the cause of PMS is hormonal imbalance, especially estrogen excess or progesterone secretion deficiency from the luteal corpus[10]. Many studies on the hormonal level comparison failed to show the absolute levels of estrogen and progesterone differ in women with PMS and non-PMS[11].

Study about nutrition intake during menstrual cycle found that there was a change in food choices that showed increased consumption of sweets and sugars[10]. Change in the quality of carbohydrate intake marked with predominant intake of simple carbohydrates from sweets and sugars in the luteal phase. This change in the intake of macronutrients, especially those from sweets, has also been associated with mood improvement during this period. It is believed that women increase carbohydrate ingestion days prior to menstruation due to an unconscious search for production of neurotransmitters related to mood improvement, since carbohydrates, especially simple carbohydrates, increase the tryptophan availability, precursor of serotonin in the brain[3].

Factors affecting the absorption of zinc is the amount and form of dietary zinc intake, diet which increases its absorption (breast milk, animal protein), diet that inhibits absorption (phytate, iron, calcium supplements), and physiological condition such as breastfeeding, pregnancy, and infant that will lead to increase absorption of zinc[12,13].

Based on the questionnaire, it was found that the dietary intake is dominated by plants-source products and high intake of carbohydrates. After the measurement of serum zinc levels using AAS. it was found that the samples had low serum zinc levels. The likelihood of zinc deficiency in people in developing countries are generally due to a combination of high protein dietary sources and inhibition in the absorption of the consumed plant-based food.[13] Food consumption patterns in developing countries predominantly derived from plant-sources food, whereas animal protein consumed slightly due to the low economic status and cultural or religious factors; thus, dietary zinc intake was found in low levels. Zinc absorption can be increased as a result of several substances such as citric acid, palmitic acid, and picolinic acid. Other substances, namely phytate (inositol hexakisphosphate) and fiber (cellulose) can inhibit the absorption of zinc. Zinc absorption derived from animal sources are better than from plant sources because of the presence of phytate[13,14].

Levels of phytic acid in the seed is quite high, therefore these compounds can absorb ions, thereby reducing the potention of minerals absorption by the human body and animals, such as Fe, Zn, Ca, Mg. In grains, 10-20% are cellular phospat such as Deoxyribo Nucleic Acid (DNA) and Ribo nucleic Acid (RNA), inorganic phospat

3-5%, and 65-75% phytic acid phospat. Phytic acid is an antinutrition compound, which in large quantities can inhibit the absorption of mineral elements essential to the body, so that these elements are disposed out of the body through urine and feces. Phytate which can also be found in foods such as nuts, seeds, wheat and grains can bind zinc, making it difficult for the body to absorb[15].

Zinc affects the sense of taste by decreasing the production of Carbonic anhydrase (CA) VI and II. CA is a zinc metalloenzyme that catalyzes the reversible hydration of carbon dioxide and is involved in the regulation of ion, fluid and acid-base balance in various tissues[16]. Gustin, another name of CA VI, is a zinc-linked proteins that affect the maintenance of taste buds. Zinc deficiency inhibits taste buds cell regeneration. The structure and function of taste buds is maintained by a balance system of cell proliferation that affected by nerves, differentiation, and apoptosis (programmed cell death)[17].

Decreased levels of CA VI lead to hyperparakeratosis of the tongue epithelium and inhibit taste buds cell proliferation. If hyperparakeratosis occurs on the surface of fungiform and circumvallate papillae, taste pore can be blocked and lead to inhibition in tastant interaction with gustatory receptors[16]. Decreased expression of CA II lead to decrease in salivary secretion that plays an important role in tasting, including tastant transport and protection against taste receptor[15].

Conclusions

Decreased levels of zinc also have impact on decreased activity of calmodulin regulated cAMP. Treatment of zinc deficient patients with supplements of zinc ions increase the gustin secretion which works by improving both function of taste and olfactory sensory receptors[18].

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Declaration of Interest

The authors report no conflict of interest.

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