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ORIGINAL ARTICLES

Relationship between pregnancy and sense of taste

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Abstract: *Background: The change in taste is common for pregnant women. This study aimed to assess the sense of taste in pregnant women in comparison with non-pregnant women.*

Methods: A cohort study was conducted on 120 healthy women. The test group (n=60) included pregnant women presenting to a hospital for pregnancy care in their first, second and third trimesters. Control group (n=60) included healthy non-pregnant women presenting to the same center. The groups were matched in terms of age, marital status and oral hygiene. Assessment of sense of taste was done for two groups using sucrose, sodium chloride and citric acid solutions for perception of sweetness, saltiness and sourness. Serial dilutions of sucrose and sodium chloride solutions were prepared in 1.0, 0.1 and 0.01mM concentrations. Serial dilutions of citric acid were prepared in 3.2, 0.32 and 0.032M concentrations. Data were analyzed using SPSS version 17 and chi square test.

Results: Forty-four non-pregnant (73.3%) and 26 pregnant (43.3%) women gave wrong answer to 0.01mM sucrose solution and this difference wasn't statistically significant (p=0.07). One individual in each group (1.7%) gave wrong answer to 0.1 and 1mM concentration of sucrose. This difference wasn't statistically significant (P=0.9). Wrong answers in the two groups and among the three trimesters weren't significantly different for sodium chloride and citric acid (P=0.9). The difference among pregnant women in the three trimesters wasn't significant for any concentration or tested solution (P=0.9).

Conclusion: The sweet taste threshold decreases during pregnancy but the perception threshold for saltiness and sourness remains unchanged.

Keywords: *pregnancy; taste; taste threshold*

INTRODUCTION

Change in the sense of taste is a common complaint of pregnant women and can result in alterations in their nutritional regimen [1]. Nutrition of mother during pregnancy is a critical factor in health of mother and fetus. Poor quality of nutrition during pregnancy can lead to nutritional deficiencies, weight gain, and increased risk of pregnancy diabetes, high blood pressure and problems during delivery [1]. The pregnant women in their second trimester have higher sugar cravings [2]. The changes in sense of taste have a relatively high prevalence in pregnant women (26%) and most pregnant women in their study showed increased sensitivity to bitterness and decreased sensitivity to saltiness [3]. The sense of taste changes during pregnancy especially in the first trimester [4]. Change in sense of taste can serve as a protective mechanism since pregnant women have less craving for bitter foods, which often contain toxic agents and by doing so, the fetus is protected against toxic nutrients [5].

The mechanism of change in sense of taste during pregnancy has yet to be fully understood. However, hormonal alterations as the cause of changes in taste during pregnancy [6]. Changes in nervous system are also a suggested mechanism for change in sense of taste during pregnancy [7].

The studies on changes in sense of taste during pregnancy have yielded controversial results and discussed that this controversy might be attributed to different methodologies

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of studies and methods of assessment [8]. Also, change in sense of taste may be variable in different trimesters and it has been shown that alternations in sense of taste have the highest prevalence in the first trimester and decrease later in the course of pregnancy. The sense of taste returns to normal after delivery [3]. This study aimed to compare the sense of taste in pregnant women in different trimesters in comparison with non-pregnant women in the Mirzakoochak Khan Hospital, Tehran, Iran.

METHODS

Research design

This historical cohort study was conducted at the Gynecology and Obstetrician Department of Mirzakoochak Khan Hospital Tehran, Iran.

Research subjects

A total of 120 pregnant and non-pregnant women (60 pregnant and 60 non-pregnant women) were included into the study. The sample size was calculated based on a pilot study conducted on 10 pregnant and 10 non-pregnant women; the difference in percentage of wrong answers between the two groups was 20%. Considering the confidence interval of 90% and study power of 80%, sample size was calculated to be 60 in each group (a total of 120 in the two groups) [9].

Pregnant women comprised the test group and were selected among those presenting to Gynecology and Obstetrician Department of Mirzakoochak Khan Hospital for routine pregnancy care. Pregnancy of these patients had been confirmed by urine and blood tests.

The test group (n=60) included pregnant women presenting to a hospital for pregnancy care in their first, second and third trimesters.

The control group included non-pregnant women who were selected among those presenting to the same hospital for routine checkup and matched the test group in terms of age, marital status, oral hygiene and use of prosthetic or orthodontic appliances. The inclusion criteria were absence of systemic diseases, no history of sensory disturbances in the oral cavity, no smoking, no drug intake (except for vitamin supplements), no history of radiotherapy or chemotherapy, absence of mouth dryness [10] and absence of nausea and vomiting of pregnancy.

Oral hygiene measurements

To assess oral hygiene of participants, the Turesky-Gilmore-Glickman modification of Quigley Hein index was used [11]. Disclosing tablets were used to quantify plaque accumulated on buccal and lingual surfaces of teeth. Calculated plaque index ≤2 indicated good oral hygiene and plaque index >2 indicated poor oral hygiene.

Taste perception test

The sense of taste in participants was assessed according to the method described by Saluja et al. [12]. Three serial dilutions (1/2 log concentration) of sucrose, sodium chloride and citric acid solutions were prepared to assess the perception of sweetness, saltiness and sourness. Sodium chloride and sucrose solutions were serially diluted to obtain 1.0, 0.1 and 0.01mM concentrations. Citric acid was serially diluted to obtain 3.2, 0.32 and 0.032M concentrations. The solutions were diluted using distilled water. Participants were requested to refrain from eating and drinking for one hour before testing. They were asked to rinse their mouth 10 seconds prior to testing. Next, they were requested to taste 5mL of each solution for 10 seconds and then spit it out (starting from the lowest concentration). Participants were asked to rinse their mouth in-between tastings. Each test took 5-10 minutes in each individual and a minimum interval of 30 seconds was allowed between tests. Minimum concentration of each solution perceived by each participant was recorded. Participants were classified for their taste perception into two groups of correct and incorrect taste perception [12].

Assessment of taste perception was carried out between 9-11 a.m. every morning in a relaxed position under the same conditions for all patients.

Statistical analysis

Data were analyzed using SPSS version 17 (SPSS Inc., IL, USA) and the data were compared between the test and control groups using chi square test. A $p<0.05$ was considered statistically significant. Because the study was a qualitative research based answer of pregnant women, the Chi-square should be used for statistically significantly results.

Ethical clearance

Both test and control group subjects were thoroughly informed about the study and signed informed consent forms prior to participation in the study. Participants were ensured about the confidentiality of their information. The study protocol was approved in the Ethics Committee Of Dental Branch, Islamic Azad University (code: IR.IAU.DENTAL.REC.1395, 22).

RESULTS

A total of 120 participants including 60 pregnant and 60 non-pregnant women were evaluated. The mean age was

25.1±2.6 years in non-pregnant and 26.4±3.3 years in pregnant women. The two groups were not significantly different in terms of age (P>0.05). In terms of oral hygiene, in the group of non-pregnant women, 48 had well and 12 had poor oral hygiene. In pregnant women, 50 had well and 10 had poor oral hygiene. The difference in this regard between the two groups was not significant (P>0.05).

Table 1 shows the frequency of correct and incorrect taste perceptions in the two groups based on the concentration of sucrose solution tested. As seen in Table 1, in the group of non-pregnant women, 44 (73.3%) had wrong taste perception for 0.01mM concentration of sucrose; this rate was 43.3% (n=26) in pregnant women. According to chi square test, this difference between the two groups was statistically significant (P<0.05). One participant in each group (1.7%) had wrong taste perception for 0.1mM concentration of sucrose and the two groups were not significantly different in this respect (P=0.9). One participant in each group (1.7%) had wrong taste perception for 1.0 mM concentration of sucrose and the two groups were not significantly different in this respect (P=0.9).

Table 1: The frequency distribution of taste perception of participants in the two groups based on the tested concentration of sucrose

Group/Sucrose concentration (mM)	0.01		0.1		1	
	Correct	Wrong	Correct	Wrong	Correct	Wrong
Non-pregnant	16 (26.7%)	44 (73.3%)	59 (93.3%)	1 (1.7%)	59 (93.3%)	1 (1.7%)
Pregnant	34 (56.7%)	26 (43.3%)	59 (93.3%)	1 (1.7%)	59 (93.3%)	1 (1.7%)
P value	P<0.05		P=0.9		P=0.9	

Table 2 shows the frequency distribution of participants in terms of taste perception of different concentrations of sodium chloride. As seen in Table 2, taste perception of different concentrations of sodium chloride was not significantly different between the two groups of pregnant and non-pregnant women (P=0.9).

Table 2: The frequency distribution of taste perception of participants in the two groups based on the tested concentration of sodium chloride

Group/Sodium chloride concentration (mM)	0.01		0.1		1	
	Correct	Wrong	Correct	Wrong	Correct	Wrong
Non-pregnant	14 (23.3%)	46 (76.7%)	59 (93.3%)	1 (1.7%)	59 (93.3%)	1 (1.7%)
Pregnant	15 (25%)	45 (75%)	58 (96.6%)	2 (3.4%)	58 (96.6%)	2 (3.4%)
P value	P=0.9		P=0.9		P=0.9	

Table 3 shows the frequency distribution of participants in terms of taste perception of different concentrations of citric acid. As demonstrated in Table 3, taste perception of different concentrations of citric acid was not significantly different between the two groups of pregnant and non-pregnant women (P=0.9).

Table 3: The frequency distribution of taste perception of participants in the two groups based on the tested concentration of citric acid

Group/Citric acid concentration (mM)	0.01		0.1		1	
	Correct	Wrong	Correct	Wrong	Correct	Wrong
Non-pregnant	1 (1.7%)	59 (93.3%)	59 (93.3%)	1 (1.7%)	60 (100%)	0
Pregnant	0	60 (100%)	59 (93.3%)	1 (1.7%)	59 (93.3%)	1 (1.7%)
P value	P=0.9		P=0.9		P=0.9	

Comparison of taste perception of women in the three trimesters for citric acid, sucrose, and sodium chloride showed no significant differences (P>0.05, Table 4).

DISCUSSION

The change in taste is common for pregnant women. This study aimed to assess the sense of taste in pregnant women in comparison with non-pregnant women. Forty-four non-pregnant (73.3%) and 26 pregnant (43.3%) women gave wrong answer to 0.01mM sucrose solution and this difference wasn't statistically significant (p=0.07). One individual in each group (1.7%) gave wrong answer to 0.1 and 1mM concentration of sucrose. This difference wasn't statistically significant (P=0.9). Wrong answers in the two groups and among the three trimesters weren't significantly different for sodium chloride and citric acid (P=0.9). The difference among pregnant women in the three trimesters wasn't significant for any concentration or tested solution

(P=0.9).

Table 4: The frequency distribution of pregnant women with correct taste perception of sucrose, sodium chloride and citric acid in the three trimester

Trimester/Solution	Sucrose			Sodium chloride			Citric acid		
	1	2	3	1	2	3	1	2	3
First trimester (n=20)	9	11	0	5	15	0	0	20	0
Second trimester (n=20)	13	6	1	6	13	1	0	19	1
Third trimester (n=20)	12	8	0	4	15	1	0	20	0
P value	P=0.9								

Proper and healthy nutrition plays a key role in a successful pregnancy [12]. Increased appetite is a common finding during pregnancy [14,15]. However, change in sense of taste and nutritional problems have been commonly reported by pregnant women [16]. This study compared the sense of taste of pregnant and non-pregnant women using different concentrations of sucrose, sodium chloride and citric acid solutions. These solutions were chosen for this study since they have no adverse effect on the mother and fetus.

Electrogustometric evidence shows that taste threshold increases with age. In other words, aging decreases the sense of taste [17]. These changes often commence at the age of 60 years in areas innervated by the chorda tympani and glossopharyngeal nerves and at the age of 70 years in areas innervated by the greater petrosal nerve [17]. Since the current study was conducted on 20 to 30 year-old women, the effect of age on sense of taste was not significant.

The current results revealed that the taste threshold of sucrose (sweetness) in pregnant women was lower than that in non-pregnant women. Similarly, the reduction in taste threshold of all tastes including sweetness in pregnant women [18]. Saluja et al, [12] also reported deceased taste threshold for sucrose in pregnant women. This change in taste has been attributed to hormonal changes during pregnancy. The changes in taste threshold of women during menstruation cycle and showed hyper-sensitivity to taste prior to ovulation and decreased sensitivity to taste after ovulation [19]. Since the sense of taste was found to be constant in males, such alternations in sense of taste especially for sweetness in women were attributed to female sex hormones and their alterations. They explained that increased sensitivity to taste prior to ovulation is probably attributed to high level of estrogen and decreased sensitivity to taste after ovulation is probably attributed to a combined function of estrogen and progesterone.

Our study only found a significant difference in taste of sweetness between pregnant and non-pregnant women while Kolbe et al. [20] reported higher taste threshold for all four main tastes in pregnant women. Also, Kuga et al. [4] reported increased taste threshold in pregnant women particularly in the first trimester. Difference between their results and ours may be explained by racial and ethnic differences between populations and different methodologies of the studies since Kuga et al. [4] did not perform an actual testing on participants and only questioned the participants verbally. The accuracy and reliability of this method (self-report) is somehow questionable. The method used by Kolbe et al. [20] was different from that in our study. Also, use of different concentrations of solutions can yield different results.

We did not find any significant difference between pregnant and non-pregnant women in terms of tasting saltiness, which was in line with the results of Saluja et al [12]. They reported that pregnancy does not affect on taste perception of saltiness. However, our results in this regard were in contrast to those of Brown and Toma [21], Hayes et al, [6] and Ochsenbein-Kölbleet al [18] since the afore-mentioned studies reported decreased taste threshold or higher craving for saltiness during pregnancy. These differences in the results of studies may be attributed to the use of different solutions with variable concentrations.

In our study, the difference between the two groups in terms of perception of sourness was not significant, which was in agreement with the results of Saluja et al. [12] who also reported that taste perception for sourness does not change during pregnancy. However, the some studies indicated that craving for sourness was different between non-pregnant women and those in the first, second and third trimesters of pregnancy. Also, Kolbe et al. [20] and Kuga et al. [4] indicated a change in perception of sourness in pregnant women. Racial, ethnic and geographical differences can all affect the nutritional habits of individuals and their perception of tastes such as sourness. Also, individual and genetic differences (variations in chemical receptors) can affect the sense of taste [22, 23]. It appears that each individual has their own gustation perception, and nutritional habits of individuals can also affect their taste threshold.

In general, in a healthy state, gestation of pregnant women is altered in a such a way to protect the health of mother and fetus. Changes in sense of smell of pregnant women also protect them against harmful chemicals. Changes in sense of taste during pregnancy enable consumption of a wider range of electrolytes and nutrients [20]. These changes include increased sensitivity to bitterness in the first trimester as a protective mechanism against toxins and increased craving for salty, sweet and sour foods in the second and third trimesters in order for the mother to consume a wide variety of nutrients required for the health of fetus [6]. Several physiological, psychological and social factors control nutritional habits of individuals. Psychological, physiological and behavioral factors can also affect the nutritional choice and consumption of food by pregnant women.

Several factors including oral hygiene, smoking, alcohol use, drug intake, systemic diseases and history of chemotherapy and radiotherapy may affect the sense of taste of individuals. Thus, in this study, the two groups were matched in terms of oral hygiene, and the other afore-mentioned factors were set as our exclusion criteria in order to eliminate their confounding effect on the results. This was strength of our study and has not been done in previous studies. One limitation of our study was that taste of bitterness was not evaluated. Quinine hydrochloride is often used for assessment of taste perception of bitterness. However, due to possible adverse effects of this agent on the fetus, we did not use it in our study. Future studies with larger sample sizes are required to confirm the results of this study.

CONCLUSION

The results of this study showed that the taste threshold of sweetness decreased during pregnancy but no difference was detected in taste threshold of saltiness or sourness between pregnant and non-pregnant women.

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