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DETERMINATION OF THE IMPACT OF AGE AND GENDER FOR ACTUAL AND RECOGNITION THRESHOLD LEVELS ON GUSTATION MODALITY

Abeywickrema S.[1], Navaratne S.B.[2]
Department of Food Science and Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

ABSTRACT

Sensory thresholds are associated with the level of stimuli strength which reaches to be consciously sensed. This study assesses the impact of age and gender in the alteration of actual and recognition threshold levels for sugar and salt taste modalities. Study was conducted according ISO 8589:2007 guidelines, while using a series of standard solutions. Responses were collected through a questionnaire and analyzed by multinomial regression using SPSS Statistical Software (α =0.05). Results revealed that age is negatively correlated ($P<0.05$) with both thresholds while gender was insignificant ($P>0.05$) for both gustation, that corroborate the detection and recognition of a tastant decline with the aging process. Ageing causes high declining of actual threshold level for sugar taste compared to the salt taste because degree of stimulating power of salt is more vigor than that of sugar. However, chemical energy of both constituents was less affective on the recognition threshold level.

KEYWORDS- *Actual threshold level, Ageing, Gender, Recognition threshold level, Sensory decline, Taste*

1. INTRODUCTION

Human sensory system has a strong perceptivity towards five senses including the taste. It can detect substances at very low concentrations and able to discriminate between the molecular compounds which are closely related and even small concentration variation in the same compound.

The ability of persons to detect a sense from a sample is varying from one to another but a same person too needs a different magnitude of stimuli for different perceptive responses in sensory threshold levels. The lowest stimulus capable of producing of a sensation is known as the actual or the absolute threshold level which signifies the minimum stimulus intensity. When the level of a stimulus at which it can be recognized and correctly identified is known as the recognition threshold level. For the detection and recognizing a sense actual and the recognition threshold levels are the important.

Sensory thresholds are basically depending on the perception of the respondent [1]. In many researches sensory thresholds are considered in the sector of psychophysics. Several factors can influence the sensory thresholds and the sensitivity including demographic settings, physiological factors, psychological and socio-economic factors etc. From those factors demographic settings including age and gender are the most vital factor which effect for the sensation and thresholds [2].

Sensory decline is a generic process which is mostly common to every person, yet several factors can influence the extent of the decline**.** Along with the ageing process older people often complain of reducing their sensitivity, remarkably for the blandness of taste. This affects the

nutritional state of the older adults through the loss of appetite, infections and undernourishment [3].

Ever since the loss of sensitivity is bind with the sensory threshold levels, this paper systematically discuss the effect of age and the gender for the actual and recognition sensory threshold levels of healthy persons in different aged-groups.

1.1 Statement of the Problem

Changes of human gustatory sense (taste) with ageing are generic. Some older people frequently complain as they get difficult to identify and recognize senses compared with young people. Hence the impact of age and gender for the stated sensory declining is important to analyze. Apart from the factors mentioned, effect of the gustation/taste modality on sensory loss is less assessed.

1.2 Purpose of the study

The study specifically find to;

I. Determine the impact of age and gender on the actual and recognition threshold levels.

II. Ascertain the effect of gustation/taste modalities, salt and sugar for the actual and recognition threshold levels.

1.3 Objectives of the study

I. To determine the extent of the relationship of the impact of age and gender on the sensory decline through actual and recognition threshold levels.

II. To determine the effect and dependency of the salt and sugar/sweet gustation modalities on the actual and recognition threshold levels.

2. METHODOLOGY

2.1 Selection of respondents for the study

Initially, 190 persons in three different age groups (15-30, 30-45, 45-60) in both genders (male and female) were taken and subjected to this study. However due to the screening process, six respondents were dropped down from the study due to declined in memory power as well as four were removed out due to inappropriate personal behaviors (Smoking and Chewing betel) in sensory evaluation. Selected participants were in good health, and were considered as untrained respondents in consumer panels. All the participants were recruited from a semi urban area of Matara district, Southern province, Sri Lanka.

2.2 Preparation of gustatory stimulants

The stimulants for the sense of gustation were primarily prepared series of salt and sugar solutions (Table 1).

Table 1 Concentrations of prepared salt and sugar solutions

Sample	Volume of water(cm^3)	Concentration of the Salt/Sugar solution ($moldm^{-1}$)	Weight of Sugar (g)	Weight of Salt (g)
1	1000	0.00	0.000	0.000
2	1000	0.01	3.600	0.585
3	1000	0.08	28.800	4.680
4	1000	0.15	54.000	8.775
5	1000	0.29	104.400	16.965
6	1000	0.43	154.800	25.155

Prepared salt and sugar solutions were stored in clean polymer bottles for the subsequent used in the study. Thereafter, these bottles were blind coded with three digits using random numbers in which the samples were distinctly taken.

2.3 Conducting sensory evaluation

Before attending to the sensory evaluation, each respondent was provided instructions to perform the analysis. A questionnaire was given to each respondent in which responses of the respondents were collected. Sensory evaluation was conducted in a conductive environment from 09.00 to 11.00 am & 1.00 to 4.00 pm and samples were prepared one hour prior to the

evaluation. Panelists were given instructions how to perform the test using series salt and sugar solutions separately. Sufficient quantity of the solution was provided for the respondents and asked them to taste it and to be kept on tasting until research objectives were achieved. During the evaluation, respondents were asked to taste the solution by keeping it at least 3-5 seconds and spite out it. Thereafter, mouth has to be flushed out with clean water and 20sec grace period is to be maintained to diminish sensory fatigue. Finally, responses of the responds were collected through the questionnaire provided.

2.4 Statistical Analysis

The data obtained from the study were subjected to statistical analysis using IBM SPSS Statistical Software version 22. The effect of the age and gender for the decline of sensory threshold levels were determined using the multinomial regression model. A significance level of 0.05 was taken into consideration to protect against Type I errors.

Multinomial regression analysis with parameter estimation was used to determine the effect of age and the gender towards the Actual threshold level and the Recognition threshold level for two gustation stimuli separately.

3. RESULTS

The data obtained from the study were analyzed using multinomial regression by resourcing the statistical software SPSS 22.0 version and outcome of the analysis, given in table 2 was used to interpret the results.

Table 2 Outcome of the multinomial regression analysis for two sensory stimuli, sugar and salt

	Actual threshold level		**Recognition threshold level**	
	Salt	Sugar	Salt	Sugar
Model fitting information (sig. value)	0.011	0.000	0.011	0.000
Pseudo R square test (Nagelkerke value)	0.098 (9.8%)	0.143 (14.3%)	0.110 (11.0%)	0.130 (13.0%)
Likelihood ratio test				
Intercept	0.000	0.000	0.000	0.000
Age	0.003	0.000	0.001	0.000
Gender	0.396	0.227	0.954	0.518

According to the table 2, model fitting information for actual and recognition threshold levels for two separate gustatory sensory stimuli "sugar and salt tastes" were significant ($P<0.05$). However, as Nagelkerke R^2 values were not exceeding 60% in any, there are other factors that affect for the actual and recognition threshold level except considered age and gender.

For the gustation of salt on actual threshold level, regression analysis has gained a significant intercept ($P<0.05$). From the selected demographic settings factor, the "age" was having significant correlation ($P<0.05$) with the actual threshold level, but the gender was not ($P>0.05$). Similarly, for the gustation of sugar on the actual threshold level only age was affected with a correlation ($P<0.05$), as the intercept was significant for the regression.

Recognition threshold levels for two gustatory sensory stimuli namely salt and sugar solutions were also not having a significant correlation with gender. As, the factor age was only correlated with a significant intercept according to the Likelihood ratio test.

Further actual and recognition threshold levels was examined by the parameter estimate analysis as summarized in the Table 3.

Table 3 Parameter estimates for actual and recognition threshold level

Tastant		**Actual threshold level**		**Recognition threshold level**	
		B	Sig. value	B	Sig. value
Salt	**Sample 2**; Intercept	6.673	0.001	35.936	0.000
	Age	-2.071	0.036	-16.831	0.000
	gender	-0.853	0.344	-0.056	0.957
	Sample 3; Intercept	4.608	0.020	34.166	0.000
	Age	-1.624	0.016	-16.638	0.000
	gender	-0.448	0.634	-0.023	0.957
Sugar	**Sample 2**; Intercept	35.607	0.000	35.405	0.000
	Age	-16.882	0.000	-16.817	0.000
	gender	-0.217	0.803	0.282	0.769
	Sample 3; Intercept	33.874	0.000	34.067	0.000
	Age	-16.444	0.000	-16.908	0.000
	Gender	0.379	0.670	0.804	0.423

Moreover, according to the parameter estimates (Table 3) found that slope of the actual threshold level for the salt tastant of sample 2 concentration (-2.071) is steeper than the concentration of sample 3 (-1.624). Comparatively sugar tastants have a higher slope for sample 2 (-16.882).

But for the recognition threshold level for salt taste, closer slopes and intercepts (sample 2, -16.831, 35.936, sample 3, -16.638, 34.166) were estimated under the developed regression model. Similarly for the sugar taste sample 2 has closer gradient, intercept of -16.857, 35.405 and for the sample 3 it was -16.908, 34.067.

4. DISCUSSION

The extent of the sensory threshold level's decline with the age and gender and its dependency on the type of the gustation is rarely quantified. The salt, sugar, bitter, sour and umami are considered as basic tastes. Perceiving stimuli from such gustation is highly depending on the type and the concentration of the stimuli [4]. Sensory threshold levels are associated with perceiving to identify, recognize and discriminate senses of tastes. Since taste thresholds can be varied from person to person, they are having different sensory thresholds or concentration levels of detections and the recognitions [2].

There are many factors affecting for the age related decline of actual and recognition thresholds by the value obtained for Nagelkerke R^2 (R^2<60%). This might be due to the link with biological aspects which combined with socio-economical, physiological and psychological factors towards human gustation. Even studies have examined such physiological relations through age related declines in sensation aptitude of people [5].

Actual and the recognition thresholds were negatively correlated with the age as identified by the study. Ageing causes increment of the perceiving concentration for actual and recognition threshold levels, as a decline in the sensitivity towards the salt and sugar tastes. According to

many researches age is a noticeable factor which affect in the declining of the sensory threshold levels [5], [6], [7].

Study shows that, examined sensory thresholds were not having correlation with the gender for both gustations. Since the impact of thresholds for gustation respect to the gender, might be less compared to the impact of physiological changes related with age [8]. Previous researches on the alteration of the sensation of gustation regarding gender were few to interpret as in most studies gender was not composed in alteration of actual and recognition threshold levels [2], [9].

Deprived of the hormonal and other physiological changes with the ageing, age is the major factor which affects the declining of sensory thresholds in both male and female as it affects the loss of sensor insensitiveness in taste [8].

Actual threshold level

Overall, Younger to older participants showed an alteration in identification of actual threshold level from the given gustation. Since gender has no correlation with the actual threshold level for two gustation modalities, salt and sugar; it was considered as insignificant at 5% significance level. But the age showed a negative correlation with the actual threshold level as it was clear that the detection of a minimum quantity of sugar and salt are increasing with the age. Simply it means with the ageing process actual threshold level get declined.

Estimated gradient (in sample 2) for the relationship with the age is steeper for the sugar taste than for the same order of the salt sample. The reason for this variation is the ageing causes high declining of actual threshold level for sugar taste compared to the salt taste. Main reason for this

consequence is the higher destruction rate of sugar receptor cells with the ageing process than the salt receptor cells on human tongue [10]. Since with ageing, tasting like most of the sensation may be reduced or changed. These changes can occur because of decreased blood flow to the nerve endings or to the spinal cord or brain. Nerve damages, improper behaviors of eating, long term medication and many other influences are sever the case [11]. Referring to L. Methven *et al.,* 2012; age related decrease in taste threshold and sensitivity is general, but the extent and significance of the declining is depend on the tastants as taste modalities [12].

According to George Retseek, 2013; sugar solutions are harder to taste and perceive taste [13]. This causes the higher actual threshold for sugar taste than the salt taste. Even at 0.01M concentration of salt taste is capable of stimulate the receptor cells for salt better than the same concentration of sugar. It imparts the detection of salt is higher than the sugar (regarding intercepts). Molecular structure of the compound and the pattern of stimuli perceiving affects for this phenomenon [14]. Salt (NaCl) is a simple ionic molecule while sugar, sucrose is a bit complex organic molecule. OH groups presented in the sucrose molecule should have a specific orientation with the related receptor cells. It effects the deprived detection of sugar compared to salt stimulant as ionic compounds bind with the receptor cells easily.

But some studies shows; actual threshold of sugar/sucrose varying from 1.2 to 2.6 folds with ageing [15], [16]. But for the salt (NaCl) it was found to be increase between 1.4 to 6.7 folds, with an average across the studies of 0.12%, W/W compared with the younger adults of 0.06%, W/W [17], [18]. The variation of the findings might be due to the regional changes of the participants in the study; but, these findings fall down with the fact that NaCl, salt taste and sugar tastes are having different declining pattern with the age as actual; threshold level is depend on the type of the gustation.

Recognition threshold level

Recognition threshold level falls on or a bit far from the actual threshold levels since it is the level at which a stimulus is recognized rather than detecting (ISO 5492:2008) [19]. Study confirms the negative correlation of the recognition threshold level with the age. Although the gender is insignificant for the correlation in this study, some researches show female gender show more competence in recognizing senses than male [5].

Gradients and the intercepts for salt and sugar tastes for sample 2 and 3 were closer to each other (Table 3) by means of similar variations in recognition threshold. Simply, this shows the recognition of a taste does not affect by the type of the stimuli/taste. Mojet has found that correlation is not inaccessible in between the recognition threshold level and the preferred tastant [4].

According to Schiffman (1998), the effect of the age on recognition threshold level, especially on the taste perception is complex due to high heterogeneous nature of the elderly aged public [1]. In between the age 40-50 taste buds of human tongue decreases as well as rest get start to shrink even after age 60, human losses the ability of recognizing a taste [10].

5. CONCLUSION

Actual threshold level and Recognition threshold level were having negative correlation with the age, but not with the gender. Simply, ageing degrade the ability of the identification of senses. Actual threshold level has a significant impact from the type of the stimulant while recognition threshold level having no or less impact.

Overall, sensory decline along with the aging process is common, in which the magnitude of perception and the significance of the impact are varied between taste modalities and the perception. This considerate could help older adults to get rid of under nutrition, loss of appetite by development of enhanced foods to compensate sensory losses.

6. RECOMMENDATIONS

Sensory loss is critical for elderly ages (usually beyond 45 years) but less affected from the gender. And detection of salty and sweet taste is dependent on the modality but recognition is not. Hence it is recommended to use taste enhances for the food products for elderly ages within the acclaimed healthy ranges and further invention of new taste substitutes to overcome effect of age on sensory threshold for the healthy ageing; by considering the findings of the study.

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