

Ageing is Correlated to Salt Taste Threshold among Elderly (Penuaan Berkorelasi dengan Ambang Rasa Garam dalam Kalangan Warga Tua)

FARAPTI FARAPTI^{1,2}, CHUSNUL FADILLA², NURINA HASANATULUDHHIYAH^{1,3}, PURWO SRI REZEKI⁴ & MUHAMMAD MIFTAHUSSURUR^{5,6*}

¹Doctoral Program of Medical Science, Faculty of Medicine, Universitas Airlangga, Indonesia

²Department of Nutrition, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia

³Department of Pharmacology, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia

⁴Department of Physiology, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia

⁵Gastroentero-Hepatology Division, Department of Internal Medicine, Faculty of Medicine-Dr. Soetomo Teaching Hospital, Universitas Airlangga, Surabaya, Indonesia

⁶Helicobacter pylori and Microbiota Study Group, Institute Tropical Disease, Universitas Airlangga, Surabaya, Indonesia

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ABSTRACT

Ageing may coincide with an increasing taste loss that can affect intake and consequently produce negative health impact. This study was conducted to analyze salt taste threshold (STT) in older people and investigate the correlation between ageing and STT among elderly in the nursing home. Recognition threshold of salty was measured using sodium chloride in liquid with the 3 ascending concentration series method. This study showed 18.5% of subjects had poor salt sensitivity. Overall, there was correlation between ageing and STT, it means the older an elderly was, the higher the STT would be ($r=0.401$, $p=0.003$). Further analysis based on gender showed the significant increase in STT was only found in male subjects. The increasing age among elderly was associated significantly with declining salt taste sensitivity. Understanding the decline of salt taste sensitivity among ageing population in the nursing home is useful for formulating food recipes for especially hypertensive elderly.

Keywords: Ageing; elderly; nursing home; salt taste sensitivity; salt taste threshold

ABSTRAK

Penuaan mungkin berkait rapat dengan peningkatan kehilangan rasa yang boleh mempengaruhi pengambilan dan seterusnya menghasilkan kesan negatif terhadap kesihatan. Kajian ini dilakukan untuk menganalisis ambang rasa garam (STT) pada warga tua dan mengkaji hubungan antara penuaan dan STT dalam kalangan warga tua di rumah jagaan. Ambang pengiktirafan masin diukur menggunakan natrium klorida dalam cecair dengan kaedah siri kepekatan 3 menaik. Kajian ini menunjukkan 18.5% subjek mempunyai kepekaan garam yang lemah. Secara keseluruhan, terdapat korelasi antara penuaan dan STT, ini bermakna semakin tua seorang itu, semakin tinggi STT ($r = 0.401$, $p = 0.003$). Analisis lebih lanjut berdasarkan jantina menunjukkan peningkatan ketara dalam STT hanya terdapat pada subjek lelaki. Peningkatan usia dalam kalangan warga tua dikaitkan dengan penurunan kepekaan rasa garam. Memahami penurunan kepekaan rasa garam dalam kalangan populasi tua di pusat jagaan berfaedah untuk merumuskan resipi makanan untuk warga tua terutama yang mengalami hipertensi.

Kata kunci: Ambang rasa garam; kepekaan rasa garam; penuaan; rumah jagaan; tua

INTRODUCTION

The global population ageing as a consequence of increased life expectancy draws attention to the concept

of healthy ageing (General Assembly United Nations 2020) This entails the maintenance of functional ability throughout the lifespan, focusing on ensuring life years

gained are productive and healthy for older adults (Govindaraju et al. 2018; United Nations 2019). Diet is one of lifestyle factors that could have contributed to improved quality of life in elderly, so as to supporting healthy ageing (Barragán et al. 2018; Marsman et al. 2018). This should raise concern on dietary problems in elderly to be appropriately managed.

Reduced taste sensitivity is a problem that may contribute to reduced appetite, food intake and dietary quality in elderly, with possible consequence on negative health impact. Data by the Centers for Disease Control and Prevention (2017) explains that the prevalence of hypertension increases with age, even in the elderly group having the highest percentage reaching 2 times the adult age group (Fryar et al. 2017). Ageing has been implicated in the decrement of taste acuity, beginning at around the age of 60 years (Jeon et al. 2021; Schiffman 1997). The age related loss of taste receptors and changes in taste cell membranes have been suggested as underlying cause of this condition, characterized by increased taste threshold (Ng et al. 2004).

Many factors contributed importantly to reduce taste sensitivity among elderly. Malnutrition can be the cause and consequence of alterations in taste perception, and on the other hand, the aging process also increases the risk of malnutrition. Study by Jeon et al. (2021) concluded that insufficient dietary intake of elderly people appeared to influence taste sensitivities, especially salty tastes. Increased use of medication that could affect oral conditions may also induce taste alteration in elderly (Schiffman 2009). Suffering chronic diseases and psychiatric conditions were uncommon causes of taste disorders and associated with higher taste detection threshold (Doty 2018; Ng et al. 2004). The most pronounced increase in taste recognition threshold of older adults has been observed for sour and bitter tastes, but their perception of salty, sweet, and umami tastes also appear to decline with age. It has often been suggested that this probably implicates in decline of food consumption or preference on stronger flavors in elderly with taste loss, nonetheless the literature has shown in contrary, that it does not appear to make elderly prefer stronger flavors, but rather a greater consumption of sweet and salty foods.

Epidemiological studies showed that salt consumption has been established as a risk factor for cardiovascular disease (Bibbins-Domingo et al. 2010; He & MacGregor 2009; Mendis et al. 2011). In addition, Xue et al. (2020) suggested that a high level of salt taste

recognition threshold increases the risk of coronary heart disease, and the concurrence of high salt taste recognition threshold, hypertension, and diabetes further increases the risk. High salt taste recognition threshold has been associated with elevated blood pressure in healthy adults (Martinelli et al. 2020). Despite increasing studies evaluating salt taste threshold (STT) on older adults from many countries, similar studies are still lacking in Indonesia. Therefore, it has necessitated the investigation of salt taste threshold (STT) in older adults and its correlation with ageing and blood pressure among elderly in the nursing home.

MATERIALS AND METHODS

This was a cross-sectional study carried out in a government-owned nursing home located in Surabaya, Indonesia. The sample, which was selected for convenience, consisted of fifty-four elderlies, aged more than 60 years. Eligibility criteria include healthy active elderly (not on bed rest) without smell loss (for example in acute influenza disease) and no signs and symptoms of dementia. The study was approved by the local research ethics committee number 304/HRECC. FODM/VI/2020 on June 30, 2020, and the subjects consented to their participation in the study by signing the informed consent.

NUTRITIONAL STATUS AND BLOOD PRESSURE MEASUREMENT

The anthropometric data including height and weight was measured using a standardized protocol (wearing light clothing, with shoes removed) by trained researchers. Body weight measurement was performed with Bioelectrical Impedance Analysis (BIA Karada Scan HBF375) and the height was obtained using a stadiometer (capacity 200 cm, accuracy 1 mm). Body mass index (BMI) was computed as kg/m^2 , and overweight was defined as $\text{BMI} \geq 25 \text{ kg/m}^2$ (Lee et al. 2018).

The measurement of blood pressure (BP) was performed by using an Omron sphygmomanometer with following classification: normotension (systolic BP <139 and/or diastolic BP <89 mmHg), and hypertension (systolic BP ≥ 140 and/or diastolic BP ≥ 90 mmHg). Blood pressure measurement was performed twice times using a standard calibrated mercury sphygmomanometer by nurse and presented as average of each systolic and diastolic level. The elderly was asked to sit on chair and

relaxed before blood pressure measurement (ESC-ESH 2018). For subject characteristics, we ask about the number of drugs consumed per day and we classified as polypharmacy if subjects got five or more medications daily (Masnoon et al. 2017).

SALT TASTE THRESHOLD MEASUREMENT

Salt taste threshold (*salt sensitivity*) was measured using 3-AFC method, described in American Standard of Testing Materials E679 or ASTM679. Sample sets consisting of a stimulus-containing test sample and two blank samples were utilized. Recognition threshold of salty was measured using sodium chloride in liquid with 3 ascending concentration series method: 1 g, 2 g, and 4 g salt in 100 mL water (American Society of Testing and Materials 2011; Lawless 2010).

STATISTICAL ANALYSIS

All statistical analyses were performed using IBM SPSS Statistics 25 (IBM Corp., New York, USA) and R version 3.4.1 (R Foundation for Statistical Computing, Vienna, Austria). The normality of the data was assessed using the Shapiro-Wilk test and quantile-quantile (Q-Q) plots. Despite statistically significant results from the Shapiro-Wilk test, the variables did not show notable deviation from normality in the Q-Q plots. Continuous data were expressed as the mean \pm standard deviation, and categorical data were expressed as a percentage. The correlations between age, BMI/age, SDP, DBP and salt sensitivity were analyzed using Spearman's correlation analysis. The correlations were further analyzed based on gender.

RESULTS AND DISCUSSION

SUBJECTS CHARACTERISTICS

Characteristics of subjects including age, gender, BMI, nutritional status and blood pressure are listed in Table 1. The average age of subjects was 71.28. Female subjects (75.9%) were more than 3 times higher in number than the male (24.1%). The mean BMI was 21.6 ± 4.57 kg/m². The elderlies with wasting were quite high (22.2 %), although the nutritional status of most subjects categorized as normal (61.1 %). The average blood pressure was $127.03 \pm 17.96/73.03 \pm 9.06$. Fifteen (27.8%) subjects were found to have hypertension. According to systolic blood pressure level 15 (27.8%) subjects were having hypertension, and 5 (9.3%) were prehypertension. According to diastolic blood pressure

level, 3 (5.6%) subjects were categorized as hypertension and 1 (1.9%) subject was prehypertension. Most of the subjects had a history of hypertension (37%) and uric acid (33.3%).

Age is associated with lower salt sensitivity in elderly group. Our study showed that age was significantly associated with declining salt sensitivity. Previous study showed more than one-half of the population between 65 and 80 years have demonstrable loss, over 80 years this increases to more than three quarter. The increasing taste threshold with advanced age results in reduced taste sensitivity (Mitchell, Brunton & Wilkinson 2013). This is a consequence of reduced salivary flow concerning with aging (Saunders & Yeh 2013). Additionally, in elderly tongue papillae would become atrophy, thus the dorsal tongue would turn into smooth aspect. Histopathology study indicates that tongue atrophy begins from the tip and lateral side of the tongue. Consequently, the tastes which are predominantly impaired in elderly are the sweet and salt tastes (Saunders & Yeh 2013; Wilujeng, Rochmah & Susetyowati 2013). Therefore, elderly group commonly experience decreased tasting ability. Furthermore, Wessler, Hummel and Maurer (2014) showed older adults often have compromised salt taste and higher dietary salt affinity due to age-related changes such as comorbid conditions, medication use, and micronutrients abnormalities. Literature review has shown that taste loss does not appear to make elderly prefer stronger flavors, but epidemiological surveys have pointed to a greater consumption of sweet and salty foods (Sergi et al. 2017).

SALT TASTE SENSITIVITY

The salt taste sensitivity was described in Table 2. It was found that 10 (18.5%) participants were having poor salt taste sensitivity. Based on gender higher percentage (30.8%) of male subjects were having poor salt taste sensitivity. Meanwhile 6 (14.6%) female subjects showed poor salt taste sensitivity.

Several studies showed taste detection thresholds increased with age across all taste modalities and taste perception declines during the healthy ageing process (Barragán et al. 2018; Methven et al. 2012). The recognition salt thresholds of elderly were significantly higher than those of young participants (Fukunaga, Uematsu & Sugimoto 2005; Yoshinaka et al. 2016). Our study found that 18.5% participants were having poor salt taste sensitivity. Based on gender, higher percentage (30.8%) of male subjects were having poor salt taste sensitivity. This is similar to previous studies that women

TABLE 1. Characteristics of subjects

Variable	Elderly (n=54)
	Mean / n (%)
Age (years)	71.28 ±8.21
Gender	
Women	41 (75.9)
Men	13 (24.1)
History of Disease	
Hypertension	20 (37)
Diabetes Mellitus	8 (14.8)
Uric Acid	18 (33.3)
Hypercholesterolemia	8 (14.8)
Medication drugs daily	
<5 drugs	44 (81.5)
≥ 5 drugs (polypharmacy)	10 (18.5)
BMI (kg/m ²)	21.6 ±4.57
Nutritional status	
Wasting	12 (22.2)
Normal	33 (61.1)
Overweight	9 (16.7)
SBP	
Normal	34 (63.0)
Pre HT	5 (9.3)
HT	15(27.8)
DBP	
Normal	50 (92.6)
Pre HT	1(1.9)
HT	3 (5.6)
Hypertension status	
Normal	39 (72.2)
Hypertension	15 (27.8)

TABLE 2. Salt taste sensitivity

Variable	Elderly (n=54)
	Salt sensitivity n (%)
Test score	
0	-
1	3 (5.6)
2	7 (13)
3	44 (81.5)
Category of sensitivity	
Less	10 (18.5)
Good	44 (81.5)
Men	
Less	4 (30.8)
Good	9 (69.2)
Women	
Less	6 (14.6)
Good	35 (85.4)

showed significantly lower recognition threshold than males for salty taste, and women perceived taste significantly more intense than men (Barragán et al. 2018; Yoshinaka et al. 2016). Taste and smell decline markedly with age, greatly impacting safety, food intake, and quality of life (Doty 2018). Nevertheless, study by da Silva et al. (2014) describes that the older adults actually own highest sensitivity compared with other age groups. Since the drop of taste sensitivity among elderly could be a pathologic rather than physiologic condition, thus, healthy elderly may not experience increased taste threshold.

Statistical analysis by Spearman's correlation suggested that age was significantly associated with declining salt sensitivity ($r = -0.40$; $p = 0.003$). However, further analysis based on gender only found significant correlation in male subjects. Diastolic blood pressure was also associated with salt taste sensitivity only in male subjects ($r = 0.678$; $p = 0.011$) (Table 3).

Taste loss caused by physiological changes and pathology condition often was associated with aging,

polypharmacy and chronic disease (Sergi et al. 2017). Polypharmacy consumed by elderly might have side effect on taste dysfunction. Our study showed 18.5% subjects got polypharmacy and the most drugs consuming are antihypertensive drug since hypertension is most prevalent disease in the community. This is relevant to previous study that showed the most drugs consuming by community-dwelling older are antihypertensive drugs and the more prevalent side effects were taste alterations (de Deco et al. 2014).

Studies of chemosensory perceptions in medicated older have found that taste and smell loss is greatest for those consuming the largest numbers of drugs (Schiffman 2018). Moreover, Kinugasa et al. (2020) demonstrated that polypharmacy was associated with recognition thresholds (RTs) for four basic tastes (sweet, salty, sour, bitter) or multiple taste disturbances that were closely related to decreased energy intake. In this study, the prevalence of elderly with polypharmacy (≥ 5 drugs) was 18.5% and consumed generally by elderly aged more than 75 years old. It might be reasonable that

TABLE 3. Factors associated with salt sensitivity in elderly

Variables	Salt sensitivity
	Correlation (significantly)
Total sample	
Age	-0,401 (0.003)
BMI/age	NS
SBP	NS
DBP	NS
Men	
Age	-0.611 (0.027)
BMI/age	NS
SBP	NS
DBP	0.678 (0.011)
Women	
Age	NS
BMI/age	NS
SBP	NS
DBP	NS

NS: not significant, spearman correlation

polypharmacy was related to ageing and was correlated to salt taste threshold. Although the recent study showed polypharmacy was related with swallowing complaints but not with taste dysfunction (Fernandes et al. 2021). Hypertension predominantly occurring in elderly is caused by vascular alteration due to natural aging (Park, Kario & Wang 2015). In our study, hypertension is found in a quarter of subjects, nevertheless it is lower than what was found in a study conducted on institution-based rehabilitation in 2019 (Susanto et al. 2019). The positive correlation was also found between salt sensitivity and diastolic BP in elderly group. The higher the salt taste sensitivity, the higher diastolic BP would be. This is in consistent with a study in China describing that salt sensitivity shows positive correlation with BP, age, and female gender (Chen 2010; He et al. 2009). This finding is somewhat different with ours where significant correlation is also found in male elderly. Although salt sensitivity in elderly is high, high blood pressure can occur due to hedonic preference. Elderly preference to salt taste may produce higher salt

intake which eventually affect blood pressure (Lee et al. 2014). A recent study by Veček et al. (2020) reported that salt taste intensity is not associated with metabolic syndrome, but does involve in salt liking. The preference of salt taste intensity in elderly is mostly influenced by food history (Schwartz et al. 2018). A study on Korean elderly reported that individual with low level of knowledge about nutrition tends to have hypertension and high sodium intake (Kim, Jung & Lee 2012). The effort on salt intake restriction in elderly is necessary to be executed. Nutritional education should be done targeting the elderly and whoever responsible for their daily food consumption (Lee et al. 2014).

This study investigated salt taste threshold or sensitivity in elderly and its affecting factors. Understanding the decline of salt taste sensitivity among ageing population in the nursing home is useful for formulating food recipes for elderly particularly with hypertension. Physiologic taste decline in older adults tend to cause them add more salt in their food in order to adjust their salty perception (Fukunaga,

Uematsu & Sugimoto 2005). Taste is an essential factor influencing food consumption. Salty food preference can be described as the level of fondness to salty sensation. Taste preference also plays important role in food consumption in relation with food acceptance. Numerous epidemiological studies demonstrated that elderlies' preference on salty food (*salt preference*) may lead them to higher risk of excessive sodium intake and consequently affecting blood pressure. Therefore, in addition to exploring salt taste threshold, further studies are needed to explore taste preference, food choice, up to sodium intake or salt consumption to obtain detail about real food intake of older adults.

CONCLUSION

Almost a fifth of the elderly in nursing home have poor salt taste sensitivity. Increasing age is associated with a decrease in the ability to taste salty, thereby increasing the risk of hypertension, especially in elderly men. This can be the basis for determining the right diet for the elderly in nursing homes to maintain the quality of their health.

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*Corresponding author; email: muhammad-m@fk.unair.ac.id