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ORIGINAL ARTICLE

The Correlation of Insomnia to Hyposalivation and Xerostomia in the Elderly. A Single Centre Study

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ABSTRACT

Background: The ageing process declines organs functions and disrupts circadian rhythms, resulting in insomnia. The salivary gland's functions are affected by insomnia as well. Disorders of salivary secretion, such as xerostomia and hyposalivation, are associated with low salivary function levels. **Objective**: This study investigates the relationship between xerostomia, hyposalivation, and insomnia in the elderly. **Method**: This study is analytical observational research using a cross-sectional approach. A total of ninety-one residents of Cipayung's Tresna Werdha Budi Mulia 1 nursing home were the subjects of the study. The Summated-Xerostomia Inventory (SXI-id) questionnaire was utilised to measure xerostomia, the Insomnia Severity Index (ISI) was employed to measure insomnia, and the unstimulated salivary flow rate based on the spitting method was used to measure salivation. Data analysis was conducted using Spearman's correlation test. **Result**: A significant linear correlation was observed between the insomnia score and unstimulated salivary flow rate (r=-0.370; p=0.001) and between the insomnia score and the xerostomia score (r=0.682). **Conclusion**: In elderly people, salivary gland secretion might be impacted by insomnia.

Keywords: elderly, hyposalivation, insomnia, salivary flow rate, xerostomia

INTRODUCTION

As people age, various aspects of their lives are affected, with health being a significant concern. Ageing brings about several changes, including reduced cell and organ function and a fall in salivary gland function. This decline in bodily functions associated with ageing can lead to disruptions in circadian rhythms, which may result in insomnia or sleep disturbances. The impact of insomnia on the elderly, particularly its relationship with hyposalivation and xerostomia, is a crucial area of study.[1] which in turn causes an elderly person's salivary output to decline.[2,3] Due to decreased salivary gland function, elderly people frequently experience xerostomia and hyposalivation. It is known that 85.7% of older people have xerostomia, according to studies by Tawas et al. The International Dental Federation (IDF) reports that an objective decrease in salivary flow, or hyposalivation, affects 50% of people aged 40 or older. This number rises to 70% among the elderly population 70 years of age and above.[3]

The decline in organ functions associated with ageing can lead to disruptions in circadian rhythms, which may result in insomnia or sleep disturbances.[2–4] Sufficient sleep duration constitutes an additional critical determinant of an individual's overall health and quality of life.[5] Sleep disturbances are reported in approximately one-third of the adult population, with 6-10% exhibiting symptoms corresponding to insomnia disorders.[6] According to an Aging Multicentre study, 42% of 9,000 elderly adults aged 65 and older reported insomnia symptoms.[18] The geriatric insomnia prevalence rate in Indonesia is approximately 67%, based on the data from Dinas Kesehatan.[19]

As an outcome of insomnia, the concentration of the hormone cortisol is elevated, which subsequently suppresses the synthesis of melatonin. This disruption in bodily regulation is correlated with a decline in the functionality of the salivary glands.[7] With insomnia, it is well known that the salivary flow rate decreases.[8] This study aims to determine the relationship between insomnia and hyposalivation in the elderly based on salivary flow rate; similarly, the Summated Xerostomia Inventory (SXI) questionnaire will be used to determine the relationship between insomnia and xerostomia in the elderly.

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RESEARCH METHODS

This is a cross-sectional observational study employing analytic methodology. The Tresna Werdha Budi Mulia 1 Nursing Home, located in the Cipayung District of East Jakarta, was the site of this study. The participants of this research were nursing home-dwelling seniors aged 60 years or older who met the following inclusion criteria, including the ability to understand and answer the questionnaire and the willingness to sign an informed consent document. The exclusion criteria: (1) diseases such as Sjogren's Syndrome, salivary gland tumours, post-radiation head and neck tumours, sialadenitis, or others that could impair salivary function; (2) under medications that could interfere with salivary secretion or radiation therapy; and (3) alcohol consumption and or smoking.

The instruments utilized in this research comprised the Indonesian adaptations of two questionnaires: the Summated-Xerostomia Inventory (SXI-Id)[9] and the Insomnia Severity Index (ISI)[2] for assessing insomnia and hyposalivation, a measuring tube for sialometry. The SXI-Id questionnaire contains five questions with Likert scale options from 1-5. The Indonesian version of the ISI questionnaire contains seven questions with Likert scale options from 0-4. The XSI and ISI scores are the sum of the answers obtained. The salivary flow rate was measured for three minutes at 30-second intervals without stimulation using the spitting method.

DATA ANALYSIS

The statistical software SPSS version 27 was utilized to analyze the SXI-Id score, ISI score, and unstimulated saliva flow rate value following the Spearman correlation test. The relationships between xerostomia and insomnia, hyposalivation and xerostomia, and insomnia and hyposalivation were analysed.

RESULTS

Purposive sampling was utilized to obtain a research sample of 91 elderly residents residing in the Budi Mulia 1 nursing home who satisfied the inclusion and exclusion criteria. The demographic status of the research subjects yielded the following results: 63 subjects (69.2%) identified as female, and 28 subjects (30.8%) identified as male. Subsequently, the subjects were categorized into three age categories according to WHO classification. It was observed that the largest proportion of subjects belonged to the elderly group, specifically those aged 60-74 years (Table 1).

Table 1. Distribution of Frequencies According to Demographic Status

	Variable	n	%
Classification of elderly*	Elderly (Aged 60-74)	80	87.9
	Old (Aged 75-90)	11	12.1
	Very old (Aged >90)	0	0.0
Gender	Female	63	69.2
	Male	28	30.8

*Based on the WHO classification of the elderly individuals

Based on the results obtained from the ISI questionnaire, 79 participants out of the 91 elderly samples were found to have insomnia, representing 86.8% of the sample. The prevalence of moderate insomnia among the samples is well-documented, affecting 32 samples (35.2%) (Table 2). Forty of the 91 elderly samples were found to have severe xerostomia (44%), as determined by the SXI-Id questionnaire results. Both moderate and severe could be considered xerostomic in 67 out of 91 subjects (72.5%) (Table 3).

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Table 2. The frequency distribution of insomnia states was determined using the ISI questionnaire.

State of Insomnia*	n	%
No Insomnia	12	13.2
Mild Insomnia	28	30.8
Moderate Insomnia	32	35.2
Severe Insomnia	19	20.9
Total	**91**	**100**

* Was determined by the ISI questionnaire. 0–7 indicates the absence of clinical insomnia symptoms; 8–14 indicates mild insomnia; 15–21 indicates moderate insomnia; and 22–28 indicates severe insomnia.

Table 3: Distribution of xerostomia frequencies according to SXI-Id questionnaire scores.

State of Xerostomia*	n	%
Mild Xerostomia	24	26.4
Moderate Xerostomia	27	29.7
Severe Xerostomia	40	44.0
Total	**91**	**100**

* According to the SXI questionnaire results. A score of 5-10 indicates mild xerostomia, 11-15 indicates moderate xerostomia and 16-25 indicates severe xerostomia.

The frequency distribution of salivary flow rate for the samples assessed using the unstimulated saliva spitting method is presented in Table 4. The salivary flow rate of the samples is documented to have an average value of 0.1726 ml/min, with a range of 0 ml/min for the minimum and 0.63 ml/min for the maximum. The salivation state of the samples was classified according to the flow rate of unstimulated saliva. It was observed that a significant proportion of the samples, specifically 37 (40.7%), showed low salivation and 29 (31.9%) very low flow of saliva. These two groups would represent of majority 73.6% low salivation rate (Table 5).

Table 4. Frequency distribution of salivary flow rate

Variable	n	Minimum	Maximum	Mean
Unstimulated salivary flow rate (ml/min)	91	0	0.63	0.1726

Table 5. Distribution of salivation state

State of salivation *	n	%
Very low	29	31.9
Low	37	40.7
Normal	25	27.5
Total	**91**	**100**

* According to measurements of unstimulated salivary flow rate. A salivary flow rate of less than 0.1 ml/min is considered extremely low, 0.1-0.25 ml/min is considered low, and >0.25 ml/min is considered normal.

The scoring data obtained from the ISI questionnaire was utilized to analyze the subject's insomnia status. Salivation rate was determined by analyzing the subject's unstimulated salivary flow rate data. Xerostomia was assessed using the scoring data obtained from the SXI-Id questionnaire. The results of the correlation test between unstimulated salivary flow rate for assessing hyposalivation and

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ISI questionnaire scores for assessing insomnia are presented in Table 6. A moderate negative linear correlation (r=-0.370) was observed between unstimulated salivary flow rate and ISI questionnaire scores; hyposalivation decreased with increasing insomnia severity. The correlation test outcomes between the scores obtained from the ISI and SXI-Id questionnaires, which were utilized to evaluate xerostomia, are presented in Table 7. A moderate positive linear relationship was observed between the scores obtained from the ISI and SXI questionnaires (p=0.001; r=0.682); in other words, xerostomia became more severe as insomnia severity increased. The correlation test results between unstimulated salivary flow rate and SXI questionnaire scores are presented in Table 8. A moderate negative linear relationship was observed between unstimulated salivary flow rate and SXI-Id questionnaire score (p=0.001; r=-0.403); in other words, xerostomia became more severe as the salivation decreased.

Table 6: Relationship between insomnia and hyposalivation

Variable	n	*p-value*	*r-value*
ISI Questionnaire Score - Unstimulated Salivary Flow Rate	91	0.001	-0,370

Table 7. Relationship between insomnia and xerostomia

Variable	n	*p-value*	*r-value*
ISI Questionnaire Score–SXI-Id Questionnaire Score	91	0.001	0.682

Table 8. Relationship between hyposalivation and xerostomia

Variable	n	*p-value*	*r-value*
Unstimulated Salivary Flow Rate – SXI-Id Questionnaire Score	91	0.001	-0.403

DISCUSSION

Consistently, both the result of SXI-Id and sialometry showed 67 subjects (73.6%) and 66 subjects (72.6%) exhibited xerostomia of 91 subjects (Table 3 and Table 5, respectively). The findings of this investigation are consistent with those of Ayuningtyas et al., who examined 19 samples aged 55 years or older and discovered that hyposalivation was present in the majority of 11 (57.9%) of the 19 samples, as determined by unstimulated salivary flow rate measurements ($<0.1 \pm 0.05$ ml/min).[10] The primary cause of impaired salivary secretion in the elderly is the ageing process.[11] The function of the salivary glands in the elderly is compromised due to a reduction in the number of acinar cells within them. Consequently, saliva production and secretion decline, resulting in symptoms of xerostomia and hyposalivation.[10]

Based on the results of the ISI questionnaire, this study reveals that among 91 subjects, 79 elderly subjects (86.8%) experienced insomnia. The remaining 12 subjects (20.9%) did not report suffering from insomnia (Table 2). The findings of this study are consistent with those of Sumirta et al., who examined 30 subjects aged 55-84 years and discovered that insomnia was present in every subject.[12]

As individuals age, their body's capacity to tolerate variations in sleep-wake cycles or hours diminishes, resulting in a diminished and irregular circadian rhythm. In addition to circadian rhythm disruption, various precipitating factors contribute to insomnia among the elderly. These include stressful situations such as bereavement, residential relocation, or significant interpersonal disputes, all of which have the potential to escalate stress levels.[13]

The correlation between insomnia and hyposalivation in the elderly is significantly and strongly correlated in Table 6 ($p<0.05$). The severity of the insomnia corresponds to the severity of the hyposalivation. Subsequently, the correlation test results presented in Table 7 indicate a moderately significant linear relationship ($p<0.05$) between insomnia and xerostomia among the elderly. Moreover,

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xerostomia worsens with the severity of insomnia. Based on the outcomes of the two analyses, a correlation between insomnia and salivary secretion can be established.

The findings of this research are consistent with those of Kurniawan et al., who examined 40 samples with an average age of 32.33 ± 2.9 years. Their research revealed that mild stress was indicated by low cortisol hormone levels (0–0.5 µg/dl) in 25 samples (62.5%) that responded to the Perceive Stress Scale (PSS-10) questionnaire. These samples also exhibited a significant moderate negative linear relationship between stress-induced insomnia and salivary secretion, with a p-value of 0.013 ($p<0.05$) and an r-value of 0.36.[12]

Lopez-Jornet et al. have also conducted studies on xerostomia in subjects with sleep disorders, measuring the severity of xerostomia with the Xerostomia Inventory (XI) and the severity of sleep disorders with the Pittsburgh Sleep Quality Index (PSQI) and Epworth Daytime Sleepiness Scale (EES). The research included 30 controls and 30 subjects. The xerostomia group showed a significant difference in both the PSQI score (5.33±1.78 vs 4.26±1.01) and EES score (5.7±2.1 vs 4.40±1.7) when compared to the control group.[14] In the study by Apessos et al., PSQI scores likewise revealed a significant difference between the hyposalivation group (63 participants) and the control group (110 subjects).[15]

One of the factors that influences salivary secretion is circadian rhythm, as the volume of saliva increases during the day and diminishes at night. The total protein concentration is at its maximum throughout the day, whereas the production of sodium and chloride reaches its apex in the early morning hours. Primary salivation is when sodium and chloride production is at its apex; therefore, a disturbance in the circadian rhythm will impede primary saliva production, reducing salivary flow among individuals with insomnia compared to those with sleep disturbances.[16] Circadian rhythms have the potential to influence the hormone cortisol. Insomniacs, for instance, will experience an elevation in cortisol levels when sleep duration is suboptimal. This cortisol surge will subsequently impact the hypothalamic-pituitary-adrenal (HPA) component, which regulates salivary flow rate. Insomnia-induced elevation of cortisol hormone levels will consequently lead to a decrease in salivary secretion.[11] Due to an increase in physical and mental illnesses as well as a decline in age-related sleep quality, insomnia is more common in the elderly. Certain medications used to treat insomnia, such as benzodiazepines, also contribute to xerostomia and decreased salivary flow rate.[17]

The assessment of insomnia in this research was conducted using subjective measurement instruments, specifically the Insomnia Severity Index (ISI) questionnaire. No objective measurements were obtained, which would have provided a more comprehensive evaluation of insomnia. To assess salivation in subjects, this study also measured the unstimulated salivary flow rate; this rate indicates minor salivary gland function more than hyposalivation. Subsequently, the elderly subjects may have confounding variables, including unanalyzed systemic disorders and medications that may have an impact on the prevalence of insomnia, xerostomia, and hyposalivation. Insomnia and salivary secretion require additional investigation; this can be accomplished by using a more comprehensive measuring instrument for insomnia and stimulating salivary flow rate for salivary secretion.

CONCLUSION

A moderate negative linear correlation ($r=-0.370$; $p=0.001$) was observed between unstimulated salivary flow rate and ISI questionnaire scores. As the severity of insomnia increases, so does the severity of hyposalivation. A moderate positive linear relationship ($r=0.682$; $p=0.001$) was observed between the scores obtained from the ISI and SXI-Id questionnaires. As the severity of insomnia increases, so does the severity of xerostomia. A notable moderate negative linear correlation ($r=-0.403$; $p=0.001$) was observed between the unstimulated salivary flow rate and SXI-Id questionnaire score. Hyposalivation advances in severity with the degree of xerostomia.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICAL CONSIDERATIONS

The ethics committee of YARSI University has approved the ethical clearance of this research.

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