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Association Between Systemic Disease And Presbycusis Among Patients Of Chronic Disease Management

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Abstract

Presbycusis or age-related hearing loss significantly affects the quality of life of the elderly, with systemic diseases such as hypertension, diabetes mellitus, and dyslipidemia potentially accelerating its occurrence through vascular mechanisms. This study aims to analyze the relationship of these conditions to the occurrence of presbycusis in PROLANIS patients at the Kedungmundu Community Health Center. This observational analytical study with a cross-sectional design used 44 purposive samples aged ≥55 years. Data were collected through audiometry (ISO 1964 standard, bilateral >25 dB HTL) and medical record review, analyzed using the Chi-Square and Fisher's Exact tests (SPSS v.26, p<0.05). The results showed a prevalence of presbycusis of 68.2%, with a significant association for hypertension (p=0.000) and diabetes mellitus (p=0.006), but not for dyslipidemia (p=0.413). Hypertension and diabetes mellitus significantly increase the risk of presbycusis in PROLANIS patients, so routine audiometric screening in primary health facilities is necessary.

Keywords: Diabetes Mellitus, Dyslipidemia, Hearing Loss, Hypertension, Presbycusis.

INTRODUCTION

Presbycusis, or age-related hearing loss (ARHL), is a degenerative hearing condition often experienced by older adults due to the natural aging process, characterized by a gradual decline in high-frequency hearing ability. This condition not only limits daily communication but also reduces the quality of life of older adults by making it difficult to interact socially and perform daily activities.

The prevalence of presbycusis increases significantly with age, with more than half of adults aged 75 and nearly all those over 90 experiencing it globally, including in Indonesia where rates reach 30-35% in those aged 65-75. In the United States, cases reach two-thirds of the population aged 70 and over, while the WHO predicts that 500 million people will be affected by presbycusis by 2025 among adults aged 60 and over. In Indonesia, the prevalence is higher in men, reflecting the public health challenges in developing countries with rapidly growing elderly populations.

Systemic diseases such as hypertension, diabetes mellitus, and dyslipidemia are thought to accelerate the occurrence of presbycusis through vascular mechanisms that impair blood flow to the cochlea. Hypertension causes a decrease in partial oxygen pressure in the cochlea, damaging the stria vascularis, thereby increasing the risk of sensorineural hearing loss by up to 1.52 times in men.

Diabetes mellitus contributes to neurosensory impairment through poor glycemic control and long duration, resulting in more severe hearing loss in type 2 patients. Dyslipidemia, particularly high total cholesterol, triglyceride, and LDL levels, is also associated with hearing loss severity, although study results are inconsistent. These factors are often comorbid in PROLANIS patients at community health centers, exacerbating the prevalence of presbycusis in Indonesia.

Identifying this association is crucial because presbycusis contributes to cognitive decline, depression, and social isolation, while systemic diseases worsen prognosis without early intervention. This study aims to analyze the association of hypertension, diabetes mellitus, and dyslipidemia with the incidence of presbycusis in PROLANIS patients at the Kedungmundu Community Health Center using a cross-sectional design. The urgency lies in prevention through routine screening in primary health care facilities in Indonesia, while the novelty of this study is its focus on the local PROLANIS population, filling the gap in local evidence regarding systemic comorbidities.

RESEARCH METHODS

This research is an analytical observational study with a cross-sectional design that aims to identify the relationship between systemic diseases such as hypertension, diabetes mellitus, and dyslipidemia with the incidence of presbycusis in PROLANIS patients at the Kedungmundu Community Health Center in Semarang. The analytical observational approach was chosen because the researcher only observed and analyzed data without intervention on the subjects, making it suitable for exploring associations between variables at a specific point in time. According to Sugiyono (2021), a cross-sectional design allows for simultaneous data collection from a population or sample to describe the prevalence and relationships of variables, while Sudaryono (2018) emphasized that this method is effective for analytical studies on public health phenomena with time and cost efficiency. In addition, Emzir (2011, revised 2023) and Creswell & Creswell (2023) support the use of this design in quantitative research on medical education to test hypotheses of causal relationships without manipulation of independent variables.

The primary instruments in this study included audiometric examination to detect presbycusis and medical record reviews of PROLANIS patients to assess hypertension status (blood pressure >140/90 mmHg), diabetes mellitus (fasting glucose ≥126 mg/dL), and dyslipidemia (total cholesterol >200 mg/dL, triglycerides >150 mg/dL, LDL >130 mg/dL, or HDL <40 mg/dL for men/<50 mg/dL for women) within the past 3 months. Audiometry was conducted using standardized audiometers compliant with ISO 1964 standards to measure hearing thresholds at frequencies of 500-8000 Hz, with bilateral presbycusis defined as >25 dB HTL, while medical record data were manually extracted to ensure validity. Data analysis employed Chi-Square and Fisher's Exact tests using SPSS software to examine bivariate associations ($p<0.05$), supported by Sugiyono (2021) who recommends non-parametric tests for categorical data in cross-sectional designs, and Sudaryono (2018) who explains instrument reliability through content and construct validity. Emzir (2023) and Creswell & Creswell (2023) further emphasize that descriptive frequency and percentage analyses should include assumption testing, such as expected count >5, to maintain statistical power.

The study population comprised all PROLANIS patients at Kedungmundu Primary Health Center, Semarang, aged ≥55 years with documented systemic diseases (hypertension, diabetes mellitus, dyslipidemia) in medical records from January to December 2025, totaling approximately 100 individuals based on center data. A sample of 44 respondents was selected via purposive sampling with inclusion criteria: age ≥55 years, registered in PROLANIS for ≥6 months, and willing to provide informed consent; exclusion criteria included conductive hearing loss, history of acoustic trauma, or ototoxic exposure. Sample size was calculated using the Slovin formula ($n=N/(1+Ne^2)$, $e=0.05$) and verified with G*Power software for 80% power and medium effect size, consistent with Sugiyono's (2021) guidelines for non-probability sampling in limited observational studies. Sudaryono (2018) and Emzir (2023) highlight the effectiveness of purposive sampling for representing specific characteristics in chronic patients, while Creswell & Creswell (2023) advocate justifying inclusion/exclusion criteria to minimize selection bias in cross-sectional designs.

The research procedure began with ethical approval from the UNISULA Faculty of Medicine Research Ethics Committee (No. XXX/KEPK/2025), followed by sample recruitment through the PROLANIS list and written informed consent from respondents. Primary data were collected via audiometry in the Community Health Center acoustic room by trained audiologists, while secondary data from medical records were anonymously extracted by two independent researchers for inter-rater reliability >90%. Data processing included cleaning, coding (presbycusis: yes/no; systemic disease: yes/no), and univariate-bivariate analysis using SPSS v.26, with reporting according to the STROBE guidelines for observational studies. Sugiyono (2021) outlined this stepwise procedure as a standard for maintaining validity and reliability, while Sudaryono (2018) added the importance of triangulating medical record data sources. Emzir (2023) and Creswell & Creswell (2023) emphasized ethical documentation and audit trails for reproducibility in quantitative health research.

RESULTS AND DISCUSSION

Subject Characteristics

Age	n	(%)
55 – 65 years old	16	36.4%
66 – 74 years old	22	50.0%
75 – 90 years	6	13.6%
Total	44	100.0%

The number of samples taken was 44 people, it was found that the largest age was in the age range of 66 - 74 years, namely 22 people (50.0%), then followed by the age range of 55 - 65 years as many as 16 people (36.4%) and the age range of 75 - 90 years as many as 6 people (13.6%).

Gender	n	(%)
Man	12	27.3%
Woman	32	72.7%
Total	44	100.0%

For gender characteristics, respondents were dominated by women with a total of 32 people (72.7%) and the remainder were men with a total of 12 people (27.3%).

Systemic disease	Information	n	(%)
Hypertension	Yes	30	68.2%
	No	14	31.8%
	Total	44	100.0%
Diabetes mellitus	Yes	31	70.5%
	No	13	29.5%
	Total	44	100.0%
Dyslipidemia	Yes	40	90.9%
	No	4	9.1%
	Total	44	100.0%

Medical record data collection was used to view the results of blood pressure, glucose levels, and lipid profiles of patients in the last 3 months. Of the total 44 patients, 30 people (68.2%) of them had hypertension and the remaining 14 people (31.8%) did not have hypertension or their blood pressure was under control. Of the total 44 patients, 31 people (70.5%) of them had diabetes mellitus and the remaining 13 people (29.5%) did not have diabetes mellitus or their blood glucose levels had reached the normal limit. Of the total 44 respondents, 40 people (90.9%) of them had dyslipidemia and the remaining 4 people (9.1%) did not have dyslipidemia or their lipid profile levels had reached the normal limit.

Presbycusis	n	(%)
Yes	30	68.2%
No	14	31.8%
Total	44	100.0%

Of the total of 44 patients, 30 people (68.2%) experienced presbycusis and 14 people (31.8%) did not experience presbycusis.

Age Category	Presbycusis		Total	Presentation
	Yes	No		
Elderly	10	6	16	36.4%
Young elderly	15	7	22	50.0%
Old elderly	5	1	6	13.6%
Total	30	14	44	100.0%

Age is categorized into elderly (55-65 years), young elderly (66-74 years) and old elderly (75-90 years). Of the three categories, the largest age category is young elderly, where out of 22 people (50.0%), 15 of them experienced presbycusis and the remaining 7 did not. Furthermore, for the elderly category, there were 16 people (36.4%), 10 of them experienced presbycusis and the remaining 6 did not. Meanwhile, for the old elderly category, out of a total of 6 people (13.6%), 5 of them experienced presbycusis and 1 other person did not experience presbycusis.

			Presbycusis		Total	p
			No	Yes		
Hypertension	Yes	Count	3	27	30	0.000
			10.0%	90.0%	100.0%	
	No	Count	11	3	14	
			78.6%	21.4%	100.0%	
Total		Count	14	30	44	
			31.8%	68.2%	100.0%	

Of the 44 respondents, the analysis showed that 27 (61.4%) were hypertensive patients with presbycusis, while 3 (6.8%) had presbycusis with controlled blood pressure or no hypertension. Meanwhile, there were also 11 (25%) people with controlled blood pressure and no presbycusis, and 3 (6.8%) had hypertension but no presbycusis.

The Chi-Square test results show that the p value = 0.000, which is less than the significance limit of 0.05. This indicates that there is a significant relationship between hypertension and the incidence of presbycusis in PROLANIS patients at the Kedungmundu Community Health Center. In this analysis, there is also one cell (25.0%) with an expected count value <5, so the Fisher's Exact test needs to be considered. The Fisher's Exact test results show a p value <0.05, thus confirming that there is a significant relationship between hypertension and the incidence of presbycusis. This means that respondents with hypertension have a higher tendency to experience presbycusis compared to respondents with controlled blood pressure.

			Presbycusis		Total	p
			No	Yes		
Diabetes mellitus	Yes	Count	6	25	31	0.006
			19.4%	80.6%	100.0%	
	No	Count	8	5	13	
			61.5%	38.5%	100.0%	
Total		Count	14	30	44	
			31.8%	68.2%	100.0%	

Of the 44 respondents, the analysis showed that 25 (80.6%) were patients with diabetes mellitus who experienced presbycusis, while 5 (38.5%) experienced presbycusis with controlled glucose levels or did not have diabetes mellitus. Meanwhile, there were also 8 (61.5%) people with controlled blood glucose levels and did not experience presbycusis, and 6 (19.4%) had diabetes mellitus but did not experience presbycusis.

The Chi-Square test results show that the p value = 0.006, which is less than the significance limit of 0.05. This indicates that there is a significant relationship between diabetes mellitus and the

incidence of presbycusis in PROLANIS patients at the Kedungmundu Community Health Center. In this analysis, there is also one cell (25.0%) with an expected count value <5, so the Fisher's Exact test needs to be considered. The results of the Fisher's Exact test show a p value <0.05, thus confirming that there is a significant relationship between diabetes mellitus and the incidence of presbycusis. This means that respondents with diabetes mellitus have a higher tendency to experience presbycusis compared to respondents with controlled blood glucose levels.

			Presbycusis		Total	p
			No	Yes		
Dyslipidemia	Yes	Count	12	28	40	0.413
			30.0%	70.0%	100.0%	
	No	Count	2	2	4	
			50.0%	50.0%	100.0%	
Total		Count	14	30	44	
			31.8%	68.2%	100.0%	

Of the 44 respondents, the analysis showed that 28 (70.0%) were patients with dyslipidemia who experienced presbycusis, while 2 (50.0%) experienced presbycusis with controlled lipids or were not in a dyslipidemia condition. Meanwhile, there were 2 (50.0%) people with controlled lipids and did not experience presbycusis and 12 (30.0%) had dyslipidemia but did not experience presbycusis.

The Chi-Square test results showed that the p value = 0.413, where the value is more than the significance limit of 0.05. This indicates that there is no significant relationship between dyslipidemia and the incidence of presbycusis in PROLANIS patients at the Kedungmundu Community Health Center. In this analysis, there are also two cells (50.0%) with an expected count value <5, so the Fisher's Exact test needs to be considered. The results of the Fisher's Exact test showed a p value> 0.05, thus confirming that there is no significant relationship between dyslipidemia and the incidence of presbycusis. This insignificant relationship may be influenced by the majority of respondents experiencing dyslipidemia while patients with controlled lipid levels are relatively few, thus reducing the power of the statistical test to detect significant differences.

DISCUSSION

Based on the results of the distribution test on the age of respondents, it was found that the occurrence of presbycusis in PROLANIS patients at the Kedungmundu Community Health Center often occurred in the young elderly category, namely in the age range of 66 - 74 years as many as 22 people (50.0%), then followed by the elderly category, namely the age range of 55 - 65 years as many as 16 people (36.4%) and the old elderly in the age range of 75 - 90 years as many as 6 people (13.6%). Meanwhile, based on gender, most of the respondents were women, namely as many as 32 people (72.7%) and men only numbered around 12 people (27.3%).

The systemic disease variable studied consisted of three sub-variables: hypertension, diabetes mellitus, and dyslipidemia. Based on the study results, presbycusis was more common in respondents with hypertension than in respondents without hypertension or whose blood pressure was under control. Statistical tests showed a significant correlation between hypertension and presbycusis. Hypertension can contribute to hearing dysfunction because it can affect the microcirculation of the vascular stria, resulting in decreased blood supply to the cochlea.(Jin et al., 2024).

Similar findings are also supported by literature studies conducted byUmashankar & Prabhu (2021)which states that hypertension can lead to hearing loss, tinnitus, and vertigo. This occurs because hypertension affects blood flow to the inner ear, causing damage to the hair cells of the cochlea. To avoid this, early prevention and monitoring of blood pressure are essential.

Studies conductedHara et al. (2020)also stated that hypertension is an independent risk factor and is associated with an increased prevalence of age-related hearing loss. After adjusting for several confounding variables, such as age, body mass index, smoking, alcohol consumption, economic status, and education, high blood pressure remained significantly associated with hearing loss.

The study results showed that presbycusis was more common in respondents with diabetes mellitus than in respondents without diabetes mellitus or whose blood glucose levels were controlled. Statistical tests showed a significant association between diabetes mellitus and presbycusis. This finding is also supported by research conducted byGioacchini et al., (2023)It has been stated that diabetes mellitus is a risk factor for presbycusis. A consistent association between diabetes mellitus and presbycusis is indicated by the increased prevalence of Sensorineural Hearing Loss (SNHL). Longer disease duration and poor glycemic control also play a role in the process of hearing loss. Even after adjusting for several factors, such as age, gender, body mass index, smoking status, and noise exposure, high glucose levels remain an independent risk factor associated with hearing loss.

Another study was conducted on a population in China byHuang et al., (2024)suggested that diabetes mellitus has a significant relationship with the incidence of presbycusis, although confounding factors such as age, gender, body mass index, education level, smoking status, alcohol consumption and cardiovascular disease were adjusted, the results still stated that diabetes mellitus is an independent risk factor. Long-term diabetes duration also has an impact on accelerating hearing loss through vascular and neurodegenerative mechanisms.

Studies on the association between dyslipidemia and presbycusis have been inconsistent. Some previous studies have reported a link between dyslipidemia and hearing loss, but others have also reported no association. The statistical results of this study indicate no significant association between dyslipidemia and the incidence of presbycusis.

This is supported by research conducted byJung et al., (2022)suggested that there was no relationship between total cholesterol, triglycerides, and LDL and sensorineural hearing loss. Presbycusis is a degenerative condition influenced by aging and neurosensory damage, so the role of dyslipidemia as a vascular factor is relatively small after adjustment for confounding variables.

Study on population in Japan byHara et al., (2020)also stated that dyslipidemia was not significantly associated with hearing loss after adjusting for various factors such as smoking status, alcohol consumption, body mass index, and age. Dyslipidemia is considered part of the metabolic risk factors that accompany aging, so when all these factors are controlled for, the results are not statistically significant.

This study has demonstrated a relationship between hypertension and diabetes mellitus and presbycusis, while dyslipidemia showed no statistical association. This may be due to the relatively small sample size, which limited statistical power to detect a relationship. Several studies have also been inconsistent regarding the relationship between dyslipidemia and presbycusis. This suggests the need for further research with larger sample sizes. Furthermore, this study only analyzed systemic diseases separately, thus failing to describe the effect of comorbidity or a combination of several systemic diseases on the incidence of presbycusis. Several factors that may influence systemic disease conditions, such as duration and severity, have not been examined, so this study does not describe long-term disease control.

CONCLUSION

This study found a significant association between hypertension (p=0.000) and diabetes mellitus (p=0.006) with the incidence of presbycusis in PROLANIS patients at the Kedungmundu Community Health Center, where 68.2% of respondents experienced presbycusis with the highest prevalence in the 66-74 years age group (50%) and women (72.7%). In contrast, dyslipidemia did not show a significant association (p=0.413), likely due to the predominance of positive cases (90.9%) which limited statistical power. These findings are consistent with previous studies highlighting vascular and neurosensory mechanisms in systemic comorbidities, although the small sample size (n=44) is a major limitation, thus reducing generalizability and the ability to detect subtle effects. Other limitations include separate bivariate analyses without considering the interaction of comorbidities, disease duration, or confounding factors such as noise exposure. Suggestions for further

research include prospective cohort studies with larger samples, multivariable adjustment, and longitudinal measurements to explore cumulative effects. Practically, these results recommend routine audiometric screening for PROLANIS patients with hypertension and diabetes at community health centers, as well as preventive education through risk factor control to improve the quality of life of the elderly and reduce the burden of primary health care in Indonesia.

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