Spousal Presence and Modifiable Factors of Cognitive Impairment among Older Adults with Hearing Loss: Cross-sectional Study using Machine Learning Approach D Jung, S Shin, S Byeon, H Seo, L Yoo*. *Gerontechnology* 25(s)

Purpose Age-related hearing loss (ARHL) is a major risk factor for cognitive decline[1] Spousal presence may influence emotional and instrumental support mechanisms related to cognitive vulnerability[2,3], but its moderating role has not been fully examined. This study aimed to (1) to identify modifiable risk factors for cognitive impairment among older adults with ARHL using a machine learning approach, and (2) to examine how risk factors for cognitive impairment operate within older adults with ARHL, according to spousal presence. **Method** A cross-sectional secondary analysis was conducted using 2023 National Survey of Older Koreans data. A total of 1,495 adults aged ≥65 years with subjective hearing difficulty were included after excluding those with diagnosed dementia or missing cognitive assessment. Cognitive impairment was defined as Korean MMSE <24. Twenty-five covariates were analyzed. Six machine learning models were trained using an 80:20 split with GridSearchCV and 5-fold cross-validation. Model performance was assessed using accuracy, precision, recall, F1 score, and area under the receiver operating characteristic curve (AUC-ROC). SHapley Additive Explanations (SHAP) were applied for model interpretability. Subgroup logistic regressions were performed stratified by spousal presence. **Result and Discussion** Among all participants, 51.7% exhibited cognitive impairment, and those without a spouse showed significantly higher impairment rates (p<.001). The random forest model demonstrated the strongest predictive performance (AUC=0.7164). SHAP analysis identified eight major predictors: age, education, frailty, self-reported health, spousal presence, instrumental activities of daily living (IADL), physical activity, and income. Distinct risk profiles emerged by spousal status. In partnered individuals, low physical activity and poorer self-perceived health were significantly associated with cognitive impairment. Among unpartnered individuals, impaired IADL and frailty were dominant risk factors, with frailty increasing the odds nearly fivefold. These findings highlight that cognitive vulnerability among older adults with ARHL is shaped by relational context. Importantly, the identified modifiable factors can be directly translated into technology-enabled risk stratification and intervention targets. These findings may inform the development of decision-support systems that dynamically identify individualized cognitive risk profiles based on spousal status. Such systems could support personalized gerontechnology interventions, including digital frailty monitoring, activity-promoting tools, or IADL-focused support platforms for unpartnered older adults, and health perception– or activity-based coaching tools for partnered individuals. Making machine learning outputs actionable in this way enhances their potential for real-world implementation in precision geriatric care and risk management for older adults with hearing loss.

References

1. Sharma RK, Chern A, Golub JS. Age-related hearing loss and the development of cognitive impairment and late-life depression: a scoping overview. Semin Hear. 2021;42(1):10-25.
2. Kim H. Gender differences in the link between marital quality and cognitive decline among older adults in Korea. Psychiatry Investig. 2021;18(7):638-646. doi:10.30773/pi.2021.0054
3. Du J, Zhang H, Liu Y. Spousal support and cognitive health among older adults: the mediating role of emotional well-being. Aging Ment Health. 2024;28(4):745-753. doi:10.1080/13607863.2022.2161740

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Table 1. Spousal status–specific modifiable predictors of cognitive impairment among older adults with hearing loss.

Group	Predictor	OR
Spouse-present	Low physical activity	0.55
	Poor self-rated health	2.15
Spouse-absent	Frailty	4.80
	IADL impairment	1.74