The study evaluated the effectiveness of noise reduction algorithms (NRA) in two hearing aids through acoustic and perceptual measures. The output from the hearing aid with noise reduction (NR) ON at three gradations (NR minimum, NR medium, & NR maximum) and NR OFF; at three signal to noise ratios (SNR) for five types of noise (cafeteria, fan, speech babble, traffic, & white noise) were recorded. The effect of NR was quantified through acoustic (Phase I) and perceptual (Phase II) measures among individuals with normal hearing (NH group) and those with hearing impairment (HI group). The data were collected on measures such as intensity of noise at the hearing aid output, Waveform Amplitude Distribution Analysis - Signal to Noise Ratio (WADA-SNR), Envelope Difference Index (EDI), Perceptual Evaluation of Speech Quality mean opinion scores (PESQ MOS), quality judgment tasks, and speech identification.

The results from acoustic analysis revealed that the overall LAeq (dB) and LA90 (dB) values for NR ON condition was lower than that for NR OFF condition, for all types of noise. The NR max provided the greatest reduction of noise followed by NR med and NR min gradations. The WADA-SNR at the hearing aid output was increased and the EDI values were lower, with NR ON compared to NR OFF condition, for all the types of noise. The NR max gradation brought about the highest SNR and lowest EDI values followed by the NR med and NR min gradations. The PESQ (MOS) did not show change across the NR gradations. Further, the speech language pathologists rated the hearing aid output as less noisy as the WADA-SNR value increased, and they rated formant representation to be better at the output of the hearing aid as EDI values decreased across NR gradation.
Likewise, the perceptual analysis revealed that the participants in both Groups (NH & HI), preferred NR max as it was less noisy, whenever it was compared with NR OFF, NR min and NR med, for cafeteria and traffic noise, in noise alone condition. In speech in noise condition, there was a negligible improvement in the mean SIS in different NR gradations for NH group. The NR max had better SNR-50 scores than NR OFF, with cafeteria and traffic noise for HI group. In the quality judgment, at NR max, the sample was rated clearer and less noisy than the other aided conditions in NH and HI groups.

Thus, it can be inferred that the NRA do bring about reduction in noise, and statistically significant improvement in speech perception in noise. The amount of NR depends on the acoustic characteristics of the input noise, how different it is from the speech signal, the input SNR and the noise reduction algorithm technology employed in the hearing aid.

Key words: Noise reduction algorithm, acoustic measure, perceptual measure, LAeq, LA90, PESQ (MOS), WADA-SNR, EDI, quality judgment, SIS, SNR-50.