

Original article:

Correlation of numeric rating scale with pure tone audiogram for assessing hearing loss.

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Abstract

Objective: Hearing loss is the public health problem affecting all the age groups. For the assessment of hearing loss pure tone audiogram (PTA) is the gold standard but cannot be easily available in rural areas. So, the main aim of our study is to see the correlation of numeric rating scale with the pure tone audiogram for assessing the hearing loss.

Materials and methods: This was the prospective, non randomized and longitudinal study performed in two hundred patients with unilateral hearing loss. For the study purpose, the numeric rating scale (NRS) was divided into 5 parts as that of degree of hearing loss and the PTA was also divided into 5 parts to see the correlation with the NRS findings. The analysis was done using SPSS 16.0 Software.

Results: The total frequency of unilateral hearing loss was 1.79%. 125(62.5%) patients fell within 16 – 25years. The mean age was 23.2+/-9.7. Females were affected more than males. Most of the patients who were in high school had unilateral hearing loss. Students and housewives accounted for 87.5%. 89% patients had conductive hearing loss, 10% had sensorineural hearing loss whereas only 1% patients had mixed hearing loss. The most of patients reported NRS2 and NRS3 which was 85.5%. Regarding the PTA analysis, 91% patients fell within mild and moderate hearing loss. There was high degree of correspondence in mild hearing loss between NRS and PTA. The Pearson's correlation showed the statistically significant correlation between NRS and PTA with p=0.00

Conclusion: The NRS scale can be used as an optional measure for PTA in assessing the hearing loss mainly in rural areas for screening where there is lack of PTA.

Key words: Hearing loss, Numeric rating scale, Pure tone audiogram

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Introduction:

Hearing loss is the public health problem which affects all the age group and it can result in frustration, losing the opportunity, need for the support and also the increase of dependency.¹

There had been several studies where there is use of questionnaire and then comparison with the pure tone audiogram (PTA) for hearing loss.^{1,2} There is also one study where visual analogue scale is used in hearing loss³ but till now there is no such study where the numeric rating scale is being used to assess the hearing loss in patients.

For the assessment of hearing loss PTA is the gold standard but cannot be easily available in rural areas so we had used Numeric rating scale (NRS) to see their correlation with degree of hearing loss by using pure tone audiogram.

Numeric rating scale (NRS) is 11 point interval ordinal scale mainly used for degree of pain assessment.⁴ We had modified this scale for assessing the hearing loss.

For measuring the degree of hearing loss, we did the PTA and used the criteria set by American academy of audiology.⁵

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The main aim of our study is to see the correlation of numeric rating scale with the pure tone audiogram in unilateral hearing loss. To the best of our knowledge this is the first kind of study in Nepal. Since in our country most of persons live in rural areas, so the main advantage of this study is that we can use the NRS to see the degree of hearing loss in patients at places where we can't perform PTA.

Materials and methodology:

This was the prospective, non randomized and longitudinal study performed in the department of otorhinolaryngology and head and neck surgery of the Kathmandu University Hospital, Dhulikhel, Kavre from 1st august 2011 to 1st august 2012. There were total two hundred patients who came with complaints of unilateral hearing loss of any cause were included. The normal ear was used as control so that the patient will be able to give the correct interpretation of hearing loss. Patients with psychiatric disorder, mentally retarded, with congenital hearing loss were excluded. Before conducting the study, informed consent was taken from the patient.

For the study purpose, the numeric rating scale was divided into 5 parts as that of degree of hearing loss. We had used scale like:

- NRS1=0 (for normal hearing)
- NRS2=1-3 (for mild hearing Loss)
- NRS3=4-6 (for moderate hearing loss)
- NRS4=7-9 (for severe hearing loss)
- NRS5=10 (for profound hearing loss)

We had used the 3 point difference for mild, moderate and severe hearing loss as most of patients come with mainly this degree of hearing loss and this 3 point difference is used as the PTA value has 15, 20 and 30dB range respectively. This helps patient to more exactly assess their hearing loss in 3 point difference.

The detailed history was taken and the patient was asked to mark the any of 5 parts of the NRS as per their hearing loss, after then the PTA was done on the same patient. The degree of hearing loss was calculated by using 4 frequencies (0.5 KHz, 1 KHz, 2 KHz and 3 KHz) averages as per criteria set by American academy of audiology. Again, the PTA was also divided into 5 parts to see the correlation with the NRS findings. The 5 parts of PTA were:

- PTA1 = Normal Hearing (0-25dB)
- PTA2 = Mild hearing Loss (26-40dB)

- PTA3 = Moderate hearing loss (41-70dB)
 - PTA4 = Severe hearing loss (71-90dB)
 - PTA5 = Profound hearing loss (>90dB)
- The analysis was done using SPSS 16.0 Software.

Results:

There were total 13,598 outpatients who came to Department of Otorhinolaryngology from 1st August 2011 to 1st August 2012. Among them 240 patients had history of unilateral hearing loss but 40 patients were excluded from the study because of congenital hearing loss, psychiatric disorder and mental retardation in them respectively. So, the total frequency of unilateral hearing loss was 1.79%.

Regarding the age distribution, 125(62.5%) patients fell within 16 – 25years. Whereas, 2(1%) patients fell in >60 years as shown in table1. The mean age was 23.2+/-9.7.

Regarding the sex distribution, females were affected more than males as shown in table2.

Most of the patients who were in high school had unilateral hearing loss as shown in table 3.

Students and housewives accounted for 87.5% as shown in table4.

Regarding the distribution of hearing loss, 89% patients had conductive hearing loss, 10% had sensorineural hearing loss whereas only 1% patients had mixed hearing loss.

Regarding the NRS, the most of patients reported NRS2 and NRS3 which was 85.5% as shown in table5. Regarding the PTA analysis, 91% patients fell within mild and moderate hearing loss as shown in table 6.

Table 7 showed the corresponding percentage between NRS and PTA. There was high degree of correspondence in mild hearing loss.

| | Frequency | Percent | Valid Percent | Cumulative Percent | |
|-------|-------------|---------|---------------|--------------------|-------|
| Valid | 0-15 years | 27 | 13.5 | 13.5 | 13.5 |
| | 16-30 years | 125 | 62.5 | 62.5 | 76.0 |
| | 31-45 years | 42 | 21.0 | 21.0 | 97.0 |
| | 46-60 years | 4 | 2.0 | 2.0 | 99.0 |
| | >60 years | 2 | 1.0 | 1.0 | 100.0 |
| | Total | 200 | 100.0 | 100.0 | |

The Pearson's correlation showed the statistically significant correlation between NRS and PTA with $p=0.00$ as shown in table 8.

Table 1. Age distribution (n=200)

| | Frequency | Percent | Valid Percent | Cumulative Percent | |
|-------|-----------|---------|---------------|--------------------|-------|
| Valid | male | 88 | 44.0 | 44.0 | 44.0 |
| | female | 112 | 56.0 | 56.0 | 100.0 |
| | Total | 200 | 100.0 | 100.0 | |

Table 2. Sex distribution (n=200)

| | Frequency | Percent | Valid Percent | Cumulative Percent | |
|-------|---------------------------------|---------|---------------|--------------------|-------|
| Valid | primary/high school certificate | 105 | 52.5 | 52.5 | 52.5 |
| | certificate | 95 | 47.5 | 47.5 | 100.0 |
| | Total | 200 | 100.0 | 100.0 | |

Table 3. Distribution of education (n=200)

| | Frequency | Percent | Valid Percent | Cumulative Percent | |
|-------|-------------|---------|---------------|--------------------|-------|
| Valid | student | 125 | 62.5 | 62.5 | 62.5 |
| | housewife | 50 | 25.0 | 25.0 | 87.5 |
| | teacher | 1 | .5 | .5 | 88.0 |
| | businessman | 2 | 1.0 | 1.0 | 89.0 |
| | farmer | 22 | 11.0 | 11.0 | 100.0 |
| | Total | 200 | 100.0 | 100.0 | |

Table 4. Distribution of occupation (n=200)

| | Frequency | Percent | Valid Percent | Cumulative Percent | |
|-------|-----------|---------|---------------|--------------------|-------|
| Valid | NRS2 | 116 | 58.0 | 58.0 | 58.0 |
| | NRS3 | 55 | 27.5 | 27.5 | 85.5 |
| | NRS4 | 27 | 13.5 | 13.5 | 99.0 |
| | NRS5 | 2 | 1.0 | 1.0 | 100.0 |
| | Total | 200 | 100.0 | 100.0 | |

Table 5. Distribution of (NRS) numeric rating scale (n=200)

| | Frequency | Percent | Valid Percent | Cumulative Percent | |
|-------|-----------|---------|---------------|--------------------|-------|
| Valid | PTA2 | 101 | 50.5 | 50.5 | 50.5 |
| | PTA3 | 81 | 40.5 | 40.5 | 91.0 |
| | PTA4 | 15 | 7.5 | 7.5 | 98.5 |
| | PTA5 | 3 | 1.5 | 1.5 | 100.0 |
| | Total | 200 | 100.0 | 100.0 | |

Table 6. Distribution of (PTA) pure tone audiogram (n=200)

| | Numeric rating scale | Pure tone audiogram | Corresponding percentage (%) |
|----------------|----------------------|---------------------|------------------------------|
| NRS2 with PTA2 | 116 | | 101 |
| NRS3 with PTA3 | 55 | | 81 |
| NRS4 with PTA4 | 27 | | 15 |
| NRS5 with PTA5 | 2 | | 3 |

Table 7. Corresponding between NRS and PTA. (n=200)

| | | Numeric rating scale | Pure tone audiogram |
|----------------------|---------------------|----------------------|---------------------|
| Numeric rating scale | Pearson Correlation | 1 | .667(**) |
| | Sig. (2-tailed) | . | .000 |
| | N | 200 | 200 |
| Pure tone audiogram | Pearson Correlation | .667(**) | 1 |
| | Sig. (2-tailed) | .000 | . |
| | N | 200 | 200 |

Discussion:

In our community, there are lots of patients suffering from hearing loss and they are mainly from rural areas. For assessing the hearing loss during the camping of that areas, PTA machine is usually not available. So, NRS scale may be helpful for hearing assessment.

There are different studies comparing self reported hearing loss with PTA, not only that but there is also study about development of questionnaire and using it for hearing assessment.^{1,2,6-11} Apart from that, there is also one study like ours which tried to see the correlation of Visual analogue scale with PTA.³

Our study showed that the frequency of hearing loss was 1.79% which differ from other study which showed the prevalence of hearing loss from 11.4% to 83%.^{1,12-14} Such a low frequency could be because of hospital based study and low sample size which shows only tip of iceberg. We can see the true picture

if we do the study in community.

The affected age group in our study was mainly young adult of 16 – 30 years which differ from study performed by Bokari S et al³ This could be because the young adults in our community are more sensitive and having good awareness about their health. Our study showed that females were affected more than male which is similar to other study.^{3,15}It could be because of the female dominated population in study community and also the male underestimate the hearing loss as compared to female.

Our study showed that the student and housewives mainly affected. The reason is students have decrease performance in class because of hearing loss so they seek medical advice whereas housewives used to have more time to seek medical advice and their population is also more. In our study, we used the NRS for comparing with the PTA because it has interval ordinal scale so it is easier to do analysis while correlating with the PTA.

We also used the single questionnaire like that did by Nondahl¹⁶ and Bokari S et al³, this however gave us the good correlation but elaborated questionnaire seems to somehow better. Because, like different study performed during time showed that a set of

specific questions showed and represent more in assessing the daily living activities.¹⁷⁻²⁰

Our study showed that there is good correlation of mild hearing loss between NRS and PTA. Also the correlation was somehow good in other degree of hearing loss Which is similar to study performed by Bokari S et al.³The correlation was also statistically significant between NRS and PTA while using Pearson's correlation coefficient. Our study also showed that there is good correspondence between NRS and PTA in conductive hearing loss, this is similar to study performed by Bokari S et al.³ It could be because in conductive hearing loss the high frequency sound is mainly preserved and thus preservation of speech perception. So, the patient is able to perceive and quantify their hearing loss in more reliable manner. The main limitation of our study is that of sample size and also the study must be conducted in community in large scale to see the exact correlation.

Conclusions:

The NRS scale can be used as an optional measure for PTA in assessing the hearing loss mainly in rural areas for screening where there is lack of pure tone audiometry.

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