

The Correlation Between Pitch and Loudness of Tinnitus with Quality of Life

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ABSTRACT

Background: Tinnitus is defined as a medical condition characterized by the perception of auditory sensations without an external sound source. Tinnitus causes harmful disruptions and ultimately reduces the patient's quality of life. The frequency and intensity of the tinnitus heard by the patient correlate with the severity of disruption and impairment of quality of life. The relationship between tinnitus frequency and intensity with patient quality of life using the Tinnitus Primary Function Questionnaire (TPFQ) questionnaire has not been reported in Indonesia. **Objective:** This study aims to prove the relationship between tinnitus sound frequency and intensity with tinnitus sufferers' quality of life. **Method:** This study was an observational analytic research design with a retrospective study (cross-sectional study) using medical record data of tinnitus patients at the Audiology Clinic of Unit of Otorhinolaryngology-Head Neck Surgery Department Dr. Soetomo Surabaya Regional General Hospital in the period August 2022 - July 2023. **Result:** The study subjects were 50 patients, 31 men (62%) and 19 women (38%), aged 18-71 years. Patients with acute complaints duration were 11 people (22%) and chronic 39 people (78%). Most patients' quality of life disruption was found on the emotional disturbance scale with an average of 52.4% disturbance, 48.6% concentration disturbance scale, 40% hearing disturbance scale, and 33.3% sleep disturbance scale. Tinnitus pitch did not correlate with the 12-item TPFQ score measuring the quality of life ($p=0.440$). Intensity was associated with the TPFQ 12-item hearing loss subscale score ($p=0.001$). **Conclusion:** Loudness of tinnitus correlates with hearing ability.

Keywords: Tinnitus; tinnitus pitch; loudness scores; TPFQ 12-item questionnaire; quality of life.

INTRODUCTION

According to the American Academy of Otolaryngology-Head and Neck Surgery Foundation (AAO-HNSF), tinnitus is a medical condition of auditory sensation without an environmental sound source. A person with tinnitus experiences the feeling of irregular acoustic sounds, often defined by ringing or buzzing, clicking, pulsing, or other sounds. These sounds are subjective because the person experiencing them may not hear or feel the same thing [4].

Tinnitus is subjective, based on what the patient describes the perception of what they hear, and it is important to note that every individual may experience distress differently depending on how

they respond or react. The etiological conditions of different individuals' tinnitus also show various impairment levels. One study showed that the most common otological factors are hearing loss followed by complaints of vertigo and hyperacusis, in addition to the influence of tinnitus characteristics such as the duration of tinnitus that appears and the loudness of tinnitus [4]. Poor quality of life is essential as it can indirectly affect daily, social, and work activities [3].

A comprehensive systematic review study of the global population reported the incidence of tinnitus in adults to be approximately 14.4%, and this study shows that tinnitus affects more than 740 million adults worldwide and as many as 120 million people,

most of whom are 65 years of age or older [7]. In the period from January 2016 to December 2018, the Neurotology Department of Neurotology Otorhinolaryngology-Head and Neck Surgery of General Hospital Dr. Soetomo Surabaya reported 420 patients with complaints of tinnitus who were registered at the Audiology Unit Otorhinolaryngology-Head and Neck Surgery, Dr. Soetomo General Hospital Surabaya [12].

The measurement of tinnitus frequency and intensity values employs the method of equalizing sound levels based on psychoacoustics. This is a subjective test. Psychoacoustics is a perceptual measurement in tinnitus that identifies auditory perception, measured in frequency, loudness, minimum masking levels (MMLs), and residual inhibition (RI). The principle of this measurement is to match the frequency and loudness of the sound perceived by the patient. Sound matching begins with a threshold at a certain level and is carefully increased until the patient can express synchronization [2].

The limited objective measurement justifies using questionnaires as a valid instrument for measuring the level of disorder in tinnitus sufferers and the extent to which the disorder affects the quality of life of the sufferers [3]. The questionnaire can be used to assess which affected areas are most disrupted. The Tinnitus Primary Function Questionnaire was developed by Richard Tyler in 2014 at the University of Iowa to assess how tinnitus can affect the sufferer's quality of life [14]. TPFQ has been shown to be a sensitive instrument for assessing the impact of tinnitus on quality of life [3]. The TPFQ is a counseling guide for tinnitus; therapy can be focused as indicated by the results of higher scoring aspects of the questionnaire. Thus, each individual can receive different therapy and rehabilitation according to the results of higher scores on certain aspects [10][14]. This questionnaire focuses on several areas that may be affected, namely a.) the sufferer's emotions, b.) hearing, c.) sleep quality, and d.) concentration. Questions on the TPFQ include affirmative sentences related to daily activities to measure the impact of tinnitus on the sufferer's quality of life. The scores obtained help to understand the person's response to tinnitus [10][14].

This research aimed to enhance the relationship between the pitch and loudness of tinnitus and the patient's quality of life [8].

METHOD

This research was an observational analytic study with a retrospective study using a cross-sectional design and conducted by taking data from medical records of patients in the audiology clinic Unit of Otorhinolaryngology-Head Neck Surgery Departement, Dr. Soetomo Hospital Surabaya in this study was an observational analytic research design with a retrospective (cross-sectional) study

using medical record data of tinnitus patients at the Audiology Clinic of Dr. Soetomo Surabaya Regional General Hospital from August 2022 - July 2023. The inclusion criteria were age 18-above, patients with medical records who had psychoacoustic records and filled TPFQ-12 item Indonesian Version, and patients able and cooperative to have the measurements and evaluation. Exclusion criteria were medical records of patients without psychoacoustic records, and the TPFQ-12 item was filled out in the Indonesian version. The data collected included age, gender, job status, and onset duration of complaints. The perception of tinnitus sound was measured using psychoacoustics, and the quality of life was obtained using the TPFQ 12-item Indonesian version. The TPFQ 12-item questionnaire used a response of 5 scales, with a total score of 0 to 100. The higher score represented the higher severity of patients' quality of life. The components of psychoacoustic measurement consist of the frequency and intensity of tinnitus sounds subjectively adjusted by the patient. The collected data were analyzed using Pearson and Spearman correlation and independent sample T-test. The relationship between variables using the Spearman correlation coefficient with a tolerance level ($p < 0.05$ =reliable). In addition, the Independent Sample T-test test is used to determine whether there is a comparison and difference between the measurement values obtained from various sample characteristics.

RESULT

A total of 50 samples were collected from medical records at the audiology clinic of Dr. Soetomo General Hospital Surabaya, with a mean age of 44,2 years old (age range 18-71) and a standard deviation of 14,9. Table 1 shows 31 male patients (62%) and 19 female patients (38%).

Onset duration of tinnitus patients with a duration of less than 6 months was 15 patients (28.3%), 7 - 12 months was 24 patients (45.3%), 13 - 18 months was 6 patients (11.3%), and complaints more than 18 months was 8 patients (15.1%). The highest range onset duration of complaints was 7-12 months, with 24 patients. The most extended duration of complaints found was 24 months.

TABLE 1: Characteristic of Subject.

Characteristics	n (%) (n=50)
Gender	
Male	31 (62)
Female	19 (38)
Ages*	
	44,2 (14,9)
Job Status	
Employed	35 (70)
Non-employed	15 (30)
Onset Duration	
≤ 6	15 (28,3)
7 - 12	24 (45,3)
13 - 18	6 (11,3)
> 18	8 (15,1)

*Mean (SD).

Table 2 shows the components of psychoacoustic, pitch, and loudness. The highest pitch found was 8000 Hz (pitch range 250-8000) and the median was 2000 with a standard deviation of 2182,2. A pitch value of 2000 Hz had the highest number of samples. The highest intensity found was 100 dB (intensity range 15-100) and the median was 55 with a standard deviation of 54,3. The highest intensity numbers were at a range of 26-50 dB.

TABLE 2: Psychoacoustic distribution.

Psychoacoustic	n (%) (n=50)
Pitch (Hz)	
250	11 (22)
500	7 (14)
1000	6 (12)
2000	12 (24)
4000	7 (14)
6000	5 (10)
8000	2 (4)
Median ± SD (Min-Maks)	2000 ± 2182,19 (250 – 8000)
Loudness (dB)	
≤ 25	4 (8)
26 – 50	19 (38)
51 – 75	18 (36)
76 – 85	5 (10)
> 85	4 (8)
Median ± SD (Min-Maks)	55 ± 54,3 (15 – 100)

The total score of the TPFQ 12-item Indonesian Version of the participant is summarized in Table 3. Overall, the minimum score is 6.25, and the maximum score is 86.67. The total percentage of 43.6% is obtained by summing all subscale percentage values and then dividing by 4, with a standard deviation of 20.4. The average subscale percentage scores from the highest were emotional (52.4%), concentration (48.6%), hearing (40%), and sleep (33.3%).

TABLE 3: Distribution of TPFQ 12-item Indonesian scores from each scale.

The scale of TPFQ 12	Mean of disruption % (SD)
Concentration scale	48,6 (26,1)
Emotional scale	52,4 (24,3)
Hearing scale	40 (29,9)
Sleeping scale	33,3 (26,3)
Total score	43,6 (20,4)

The correlation between tinnitus frequency and Tinnitus Primary function questionnaire 12 – item Indonesian Version is shown by testing the correlation of pitch and loudness with the total score of TPFQ12 and each annoyance scale. Normality test Kolmogorov-Smirnov was used to test the distribution of the TPFQ 12-item Indonesian version score data distribution is not normal (p=0.2), the distribution of tinnitus pitch data is not normal

(p=0.000), and the distribution of loudness data was abnormal (p=0.002). Correlation test between pitch and loudness of tinnitus with Spearman's test. The results of the Spearman test showed that pitch and loudness scores were not correlated with the total score of the 12-item TPFQ Indonesian version. (p=0.440) and (p=0.079). The correlation Spearman's test between pitch and loudness with each TPFQ12 disruption scale revealed no significant correlation between pitch and disruption of emotional, concentration, hearing, and sleep disorder scales (p ≥ 0,05). Conversely, loudness significantly correlated with the hearing ability disruption scale (p=0,001) and did not correlate with the other. The pitch and loudness of tinnitus.

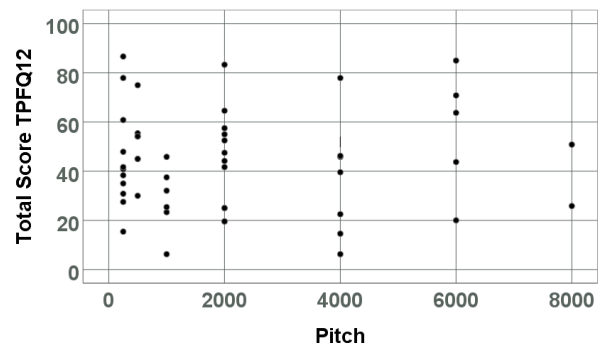


FIGURE 1: Correlation Between Pitch and Total Score TPFQ12 (p= 0,440).

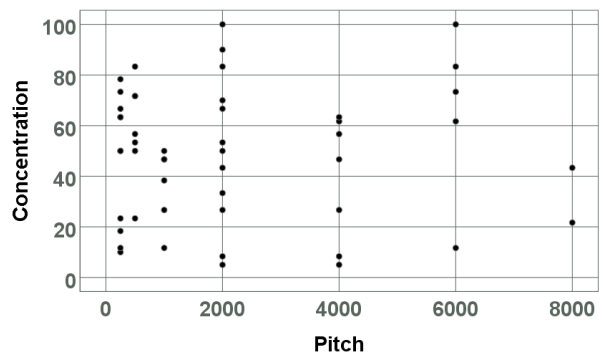


FIGURE 2: Correlation Between Pitch and Concentration scale (p= 0,899).

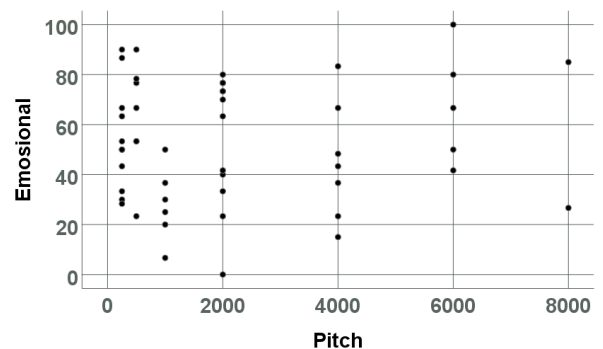


FIGURE 3: Correlation Between Pitch and Emotional scale (p= 0,898).

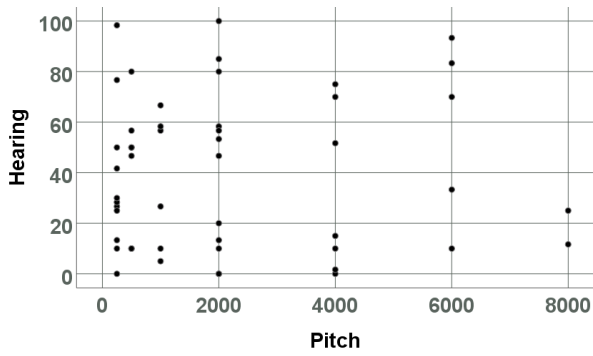


FIGURE 4: Correlation Between Pitch and Hearing scale (p=0,814).

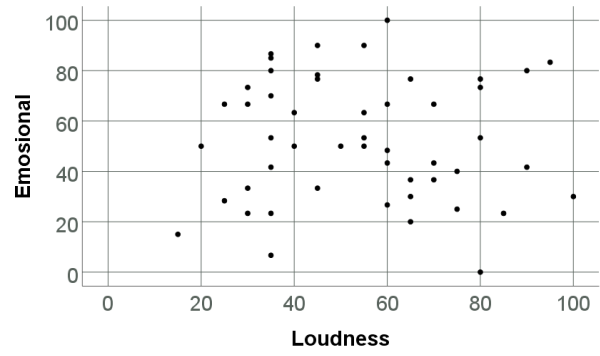


FIGURE 8: Correlation Between Loudness and Emotional scale (p= 0,860).

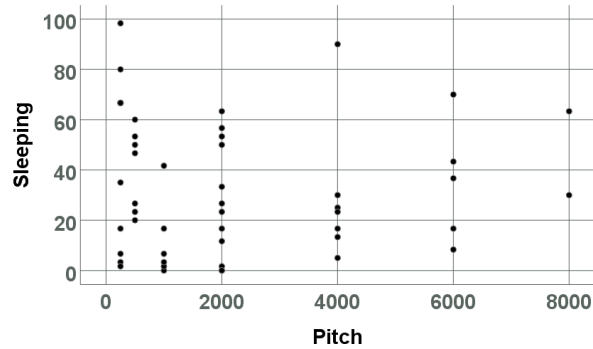


FIGURE 5: Correlation Between Pitch and Sleeping scale (p=0,471).

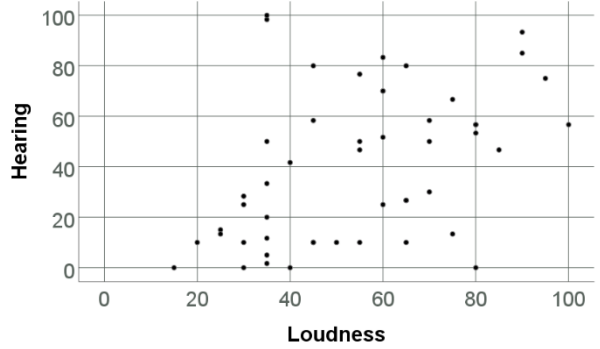


FIGURE 9: Correlation Between Loudness and hearing scale (p= 0.001).

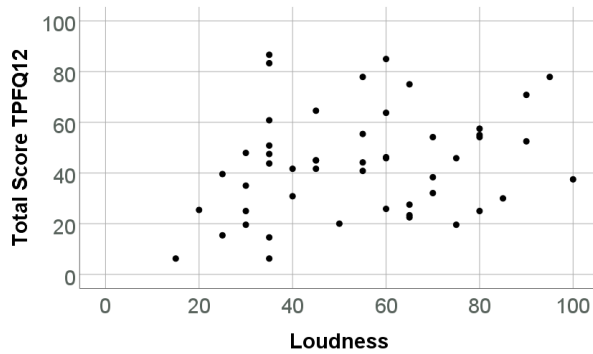


FIGURE 6: Correlation Between Loudness and Total Score TPFQ12 (p= 0,079).

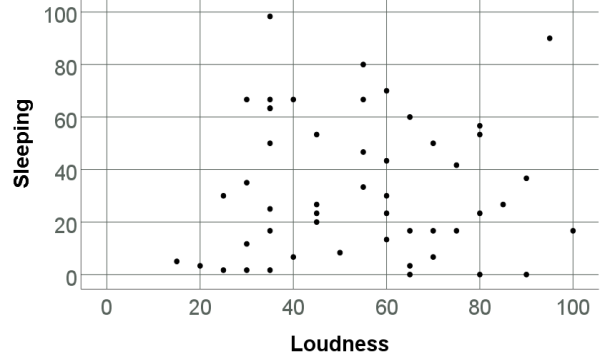


FIGURE 10: Correlation Between Loudness and sleeping (0,915).

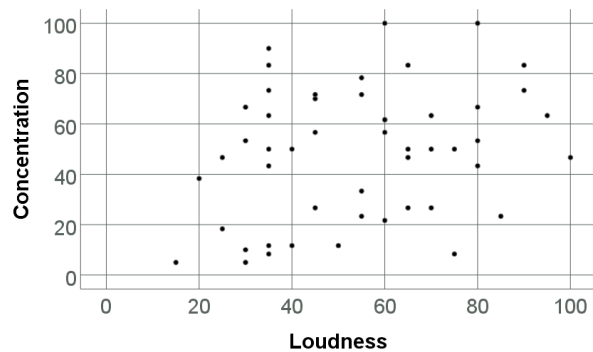


FIGURE 7: Correlation Between Loudness and Concentration scale (p= 0,074).

DISCUSSION

Our findings showed that the perception of tinnitus was measured subjectively; patients were informed to independently determine their perception of the pitch and loudness that they felt with pitch and loudness matching through an audiogram. We found a significant correlation between patients with high mean loudness of tinnitus and a high mean on the hearing disruption scale of TPFQ 12-item. The loudness of tinnitus has a role as the greatest predictive value of likeness compared to predictors for the presence of tinnitus [2]. A previous study proposed that psychoacoustic loudness should be considered as an essential and complementary measure of tinnitus [2].

In this study, the Spearman correlation test found a significant relationship or correlation between loudness values and the TPFQ-12 item hearing subscale with the result of $p = 0.001$ ($p \leq 0.05$). This study obtained results that followed [9] using the tinnitus handicap inventory (THI) questionnaire, which found a relationship between loudness and quality of life ($p = 0.043$). Subjects with intensity values ≥ 50 dB who had hearing subscale scores ≥ 50 with an average (62.2%) were more than those with scores below 50 (17 and 8) subjects. At an intensity of < 50 dB, the score with hearing loss subscale < 50 was more than the score ≥ 50 (21 and 4) subjects. This may explain the significant correlation between intensity values and hearing loss subscale scores, that impaired quality of life on the hearing scale is related to the higher intensity value of tinnitus sound that a person hears.

Patients with tinnitus frequently present with concomitant hearing loss. A previous study [4] demonstrated a correlation between tinnitus cases and hearing loss. The disorders caused by tinnitus are multifactorial. Tinnitus caused by comorbid conditions, hearing problems, the influence of the character of tinnitus, namely the duration of complaints, and the loudness of the sound felt by the patient are all factors contributing to tinnitus development [5].

The tinnitus primary function questionnaire (TPFQ) developed in 2014 by (Henry) has been evolving and was further developed by being adapted to various languages in the world, such as Indian, Korean, Chinese, and Arabic, and its validity and reliability can be trusted [10][13][14]. The 12-item TPFQ questionnaire focuses on 4 factors tinnitus affects: concentration, emotional, auditory, and sleep. When one of these 4 scales, the patient can feel problems in secondary functions such as work, socializing, relationships between individuals, and other quality of life factors [14]. Indeed, the reaction of each patient is also, of course, different depending on other factors, namely their employment status because it could be that in patients who work, tinnitus will be felt much more disturbing to them, the duration of the tinnitus appears and how the patient can get used to the condition. Measurement of disturbance in patients is very subjective.

CONCLUSION

Based on the conducted study, the conclusions can be drawn: There is a relationship between the intensity of tinnitus sound and the TPFQ12-item Indonesian Version score that measures the quality of life of tinnitus sufferers, where the associated quality of life is the hearing subscale. Meanwhile, the relationship between frequency and TPFQ12-item Indonesian Version score is unrelated.

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