AUDIOLOGY

Italian validation of the Penn Acoustic Neuroma Quality of Life Scale (PANQOL-It)

Validazione italiana del Penn Acoustic Neuroma Quality of Life Scale (PANQOL-It)

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SUMMARY

Objective. translate and validate the Penn Acoustic Neuroma Quality of Life Scale into Italian language (PANQOL-It)
Methods. the instrument was translated and psychometric properties were subsequently assessed by administering the PANQOL-It to 124 outpatients together with the Depression Anxiety Stress Scale (DASS21) and the Understanding and Communicating domain of the World Health Organization Disability Assessment Schedule II (WHODAS II-D1). The internal consistency, test-retest reliability, construct and criterion-related validity were assessed.
Results. Cronbach's alpha coefficient was 0.92 for the total score and ranged from 0.44 to 0.90 in the seven domains. Significant test-retest reliability was observed (intraclass-correlation = 0.75; p < 0.01). Moderate correlation was reported between facial dysfunction domain and objective facial involvement (p < 0.01). Moderate to strong correlations were observed between anxiety, general health domains and all subscales of the DASS21, and between WHODAS II-D1 and general health and energy domains (p < 0.01). These latter results indicated good construct and criterion-related validity respectively.
Conclusions. PANQOL-It presented more than acceptable psychometric properties and its adoption is justified for both clinical and research purposes.

KEY WORDS: vestibular schwannoma, dizziness, hearing loss, tinnitus, health

RIASSUNTO

Obiettivo. Validare in lingua italiana il Penn Acoustic Neuroma Quality of Life Scale (PANQOL-It).
Metodi. Lo strumento è stato somministrato a 124 pazienti ambulatoriali congiuntamente alle versioni italiane del Depression Anxiety Stress Scale (DASS21) e della sezione "Understanding and Communicating" del World Health Organization Disability Assessment Schedule II (WHODAS II-D1). Sono state valutate la consistenza interna, la riproducibilità, la validità di costrutto e di criterio.
Risultati. Il coefficiente alfa di Cronbach è risultato di 0,92 per il punteggio totale e compreso tra 0,44 e 0,90 nelle sette dimensioni del questionario, mentre la correlazione intra-classe è risultata significativa (ICC = 0,75; p < 0,01). Sono state osservate una moderata correlazione tra la dimensione "facial dysfunction" e il grado di paralisi del nervo facciale, da moderate a forti correlazioni tra le dimensioni "anxiety" e "general health" e il DASS21, e tra il WHODAS II-D1 e le dimensioni "general health" ed "energy" (p < 0,01). Questi riscontri indicano rispettivamente una buona validità di costrutto e di criterio.
Conclusioni. Il PANQOL-It ha presentato proprietà psicometriche ottime e la sua adozione è giustificata sia per scopi clinici che di ricerca.

PAROLE CHIAVE: *schwannoma vestibolare, instabilità, perdita dell'udito, acufene, salute*

Introduction

Vestibular schwannomas (VS), also referred to as acoustic neuromas, are benign tumours that origin from the VIII cranial nerve with growth within the cerebellopontine angle in approximately 90% of cases. Its incidence has increased over the past few years from 10.9 to 33.8 per 1,000.000 per year most probably due to the routine use of magnetic resonance imaging (MRI) [1]. In most cases, initial clinical symptoms (progressive hearing loss, tinnitus, unsteadiness, facial numbness) are mild with no/low impact on quality of life [2]. Despite the routine use of neuroimaging, there may be a significant delay between the onset of signs and symptoms and the definitive diagnosis. On the contrary, the surgical removal of the tumour often causes severe aesthetic and functional damages in the cranial-cervical district due to accidental injury to the facial, trigeminal and acoustic nerves. Taken together, these lesions account for a dramatic post-operative symptomatology and a significantly worsening of quality of life. While mortality rates are low, comorbidities are relevant in relation to remarkable psychological distress [3]. The comparison between different treatments and consequent results was barely performed across cultures and countries until 2010, due to the methodological weakness of the published studies and the lack of a disease-specific quality of life inventory. In fact, most of the studies appreciated the complexity of this clinical condition through a plethora of generic questionnaires [4]. In 2010, the first disease-specific quality of life instrument for VS, the Penn Acoustic Neuroma Quality of Life Scale (PANQOL), was developed with more than acceptable psychometric properties [5]. Up to now successful validation studies, in most widely spoken languages different from the original English version, have been carried out [6-9]. Although an Italian version of PANQOL has recently been used, there is no validation study or assessment of the psychometric properties of this instrument [10]. Hence, the purpose of the present study is to translate and validate the PANQOL into Italian in order to provide the scientific community with an Italian version of an appropriate disease-specific questionnaire for both clinical and research aims.

Methods and materials

Participants

A cohort of 124 subjects was recruited in this monocentric and cross-sectional study from July 2019 to October 2021. This sample size was adopted in accordance with the original article [5]. Only consecutive outpatients attending the Otorhinolaryngology Unit of the Azienda Ospedaliero-Universitaria of Modena (Italy), aged 18 years or more, with a diagnosis of VS or treated for VS at least six months before examination were considered. The following exclusion criteria were established: presence of a cerebellopontine angle tumour other than VS, neurofibromatosis type II, cultural barriers, major neurological or psychiatric disorders, or any other morbidity that could prevent them from understanding and answering the self-administered questionnaires by paper and pencil. Tumour characteristics were obtained from medical and surgical records; recent history, a careful bedside examination and un updated audiogram were performed in the same session. The tumour size was measured considering the maximum diameter and the extension in the internal acoustic meatus (IAM) and/or the cerebellopontine angle (CPA) according to the Koos classification [11]. Facial nerve involvement was measured considering the House-Brackmann (HB) grading system [12]. The mean pure tone average (PTA) was calculated over 500, 1000, 2000 and 4000 Hz and for the hearing level the classification of the American Academy of Otolaryngology-Head and Neck Surgery Foundation guidelines that also considers the word recognition threshold was used, whereas the unsteadiness and tinnitus were considered according to patient reports [13].

Instruments

The PANQOL is a 26-item disease-specific questionnaire for VS [5]. Each item is rated on a Likert scale from 1 ("strongly disagree") to 5 ("strongly agree") and items on a certain factor are grouped together in domains, resulting in seven scores calculated on a normalised scale from 0 to 100, from worst to best quality of life experienced. Each domain is composed by a different number of items: 6 items for balance (Ba) and energy subscales (En), 4 items for hearing loss (HL) and anxiety subscales (Ax), 3 items for facial dysfunction domain (FD), 2 items for general health domain (GH) and 1 item for the pain domain (Pa). The total instrument score is calculated as the average of domain scores. The PANQOL was translated and adapted into Italian language following the standards established by the International Quality of Life Assessment project (IQOLA), for academic use and under licence by the original authors [14]. The first phase was the reproduction of the questionnaire through an iterative translation process conducted by four bilingual audiologists of the Azienda Ospedaliero-Universitaria of Modena, Italy (Fig. 1). In this way, the Italian version of PANQOL (PANQOL-It) was obtained (Appendix A). Relationships with other scales and external variables were evaluated. In particular, facial nerve involvement, hearing level, self-perceived unsteadiness and tinnitus were considered as external variables, whereas other scales used were the Understanding and Communicating domain of the Italian version of the World Health Organization Disability Assessment Schedule II (WHODAS
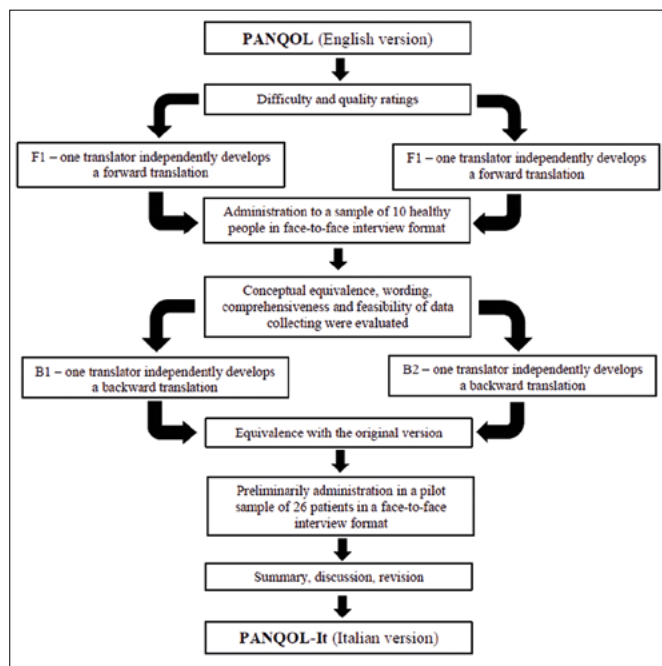
Figure 1. Iterative translation process.

II-D1) and the Depression Anxiety Stress Scale (DASS21). Hence, in addition to PANQOL-It patients were invited to complete both questionnaires already validated in Italian [15,16]. All three questionnaires were delivered to patients and self-administered by paper-and-pencil. The WHODAS II-D1 is the first domain of an instrument developed by the World Health Organization (WHO). It consists of 6 items aimed at measuring behavioural limitations and restrictions in participation experienced by an individual in the last 30 days, independently from diseases, lesions, psychological difficulties, or problems related to alcohol and drugs. Each item is ranked on a 5-point ordinal scale and higher score indicates higher disability. The DASS21 is a self-reported scale which measures symptoms of depression (De), anxiety (An) and stress (St) in both clinical and non-clinical samples of adults. It consists of 21 items, 7 for each domain, rated on a 4-point severity/frequency scale where higher scores indicate greater psychological impairment. All data were collected anonymously in a Microsoft Excel® database.

Psychometric tests and statistical analysis
Statistical analysis and graphical representation were performed with the Statistical Package for Social Sciences (IBM SPSS® version 25.0 for Microsoft Windows®). Epidemiological features of the participants were reported by descriptive statistics. Quantitative and qualitative variables were expressed as means with standard deviations (SD) and

rates respectively. One-way ANOVA test and Chi-square test were used to compare continuous and qualitative variables across different treatment groups. Given the different indications for the various therapeutic options, a significant difference in neuroma and functional parameters was expected [17]. Furthermore, PANQOL-It scores were reported by descriptive statistics in order to compare them with results from other validation studies.

As a crucial part of the validation process of PANQOL-It, different psychometric properties were evaluated [18]. The reliability is important for discriminative purposes since it concerns the degree to which patients can be distinguished from each other. It can be expressed in terms of internal consistency and reproducibility. The former is the extent to which items in a questionnaire and its domains are homogeneous. In order to assess it, the correlations among different subscales were analysed. Since PANQOL-It is a disease-specific instrument composed of items grouped together in seven different domains, significant but not high correlations across subscales were expected, whereas significant high correlations between each domain and the total score was expected. In order to measure the internal consistency Cronbach's alpha coefficient was used. It indicates the correlation among the items and should be calculated for each domain separately. Despite the use of cut-off being debated, in accordance with the international common interpretation, the minimum acceptable value of alpha is 0.7, an alpha from 0.8 to 0.9 is considered good and an alpha from 0.9 excellent. However, an alpha that is too high may suggest that some items are redundant, such as they are testing the same question but in a different guise. Thus, the statistical procedure "Cronbach's alpha if item is deleted" was performed in order to establish how much any single item contributes to the whole Cronbach's alpha coefficient. In addition, the floor and ceiling effects were calculated by percentage frequency of lowest or highest possible score achieved by subjects. A percentage > 15% indicates that the reliability is reduced due to the difficulty in distinguishing patients with the lowest or highest possible score from each other.

The reproducibility is the degree to which repeated measurements in stable patients provide a similar answer. Thus, it measures the stability of the instrument (test-retest reliability). PANQOL-It was administered a second time to 52 randomly selected patients who responded with no change in their quality of life after a six-week interval in a phone-interview format. Intraclass Correlation Coefficients (ICC) with 95% confidence intervals were used for this purpose. The construct validity refers to the ability of an instrument to measure a theoretically derived hypothesis concerning the concepts that are being measured. Even if no meaning-

ful correlation with age, gender, tumour size, or audiometric data and PANQOL subscales was reported in the original article, given the presence of seven different domains, the construct validity was assessed through a correlation study. In detail, correlations between tumour size and FD, facial involvement and FD, hearing function and HL, complaints of tinnitus and HL, self-perceived unsteadiness and Ba were evaluated. Finally, the criterion-related validity was assessed. This indicates how well the scores converge with other measures of the same construct. The PANQOL-It domains were correlated to De, An and St of the DASS21 and WHODAS II-D1. In particular, since PANQOL-It scores are calculated from 0 to 100, from worst to best quality of life experienced, whereas for WHODAS II-D1 and DASS21 higher scores indicate higher disability and greater psychological impairment respectively, significant negative correlations between Ax and An, GH and all DASS21 subscales and WHODAS II-D1, and En and all DASS21 subscales were expected. Spearman's correlation coefficient rho for ranked variables was used for all correlation studies to obtain a robust estimation even in case of non-normal distribution [19]. The level of statistical significance was considered reached if p-value was < 0.05 in all procedures.

Results

A cohort of 124 outpatients was recruited to take part in the study. Twenty-two patients (17.7%) were managed conservatively with wait and scan policy, while 98 (79.0%) and 4 (3.2%) underwent surgical resection or stereotactic radiosurgery with Gamma-Knife at least six months before recruitment respectively. Epidemiological features of the samples are represented in Table I. No significant differences in age, gender, and hearing function were observed among the various treatment groups, whereas tumour size expressed with maximum diameter and Koos classification, facial involvement, tinnitus referred and self-perceived unsteadiness were significantly different across the various treatment groups. Figure 2 shows results for the total score and the seven PANQOL-It domains in the study sample.

Reliability
Significant correlations were observed across PANQOL-It domains, except between Pa and GH (Tab. II). Correlations in general ranged from weak to moderate, whereas all domains showed moderate to strong correlations with the PANQOL-It total score. Cronbach's alpha coefficient was 0.92 in the total score and the procedure 'Cronbach's alpha if item is deleted' pointed out that removal of each item did not improve the alpha coefficient of the instrument. Specifically, the Cronbach's alpha for each domain ranged
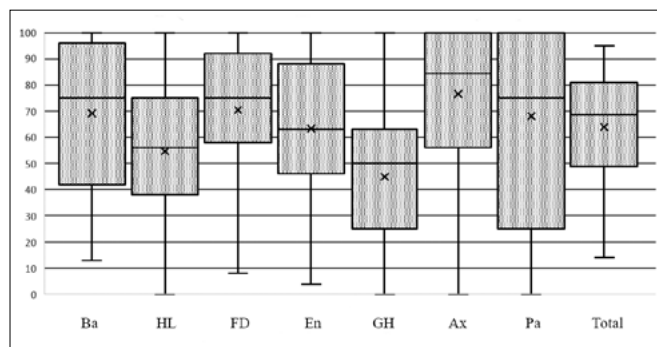
Figure 2. PANQOL-It domains and total score in the study sample. PANQOL-It: Italian version of the Penn Acoustic Neuroma Quality of Life Scale; Ba: balance domain; HL: hearing loss domain; FD: facial dysfunction domain; En: energy domain; GH: general health domain; Ax: anxiety domain; Pa: pain domain.

from 0.44 in GH to 0.90 in Ba (Tab. III). Cronbach's alpha was not applicable to Pa, since it is a single-element domain. The procedure 'Cronbach's alpha if item is deleted' showed improvement of alpha coefficient if item 9, 11 and 21 was deleted in Ba, FD and En respectively (Tab. III). No floor or ceiling effect was found considering the total score since no patients scored 0 or 100 at PANQOL-It, whereas ceiling effect was observed in Pa, Ax, GH, Ba. ICC obtained in the two distinct administrations resulted in 0.75 for PANQOL-It total score and ranged from 0.42 for En to 0.94 for Pa (Tab. III).

Construct validity
Tumour size and facial nerve involvement significantly correlated with FD. In addition, very weak and weak correlations were observed with tumour maximum diameter (rho = -0.20; p < 0.05) and tumour extension (rho = -0.30; p < 0.01), respectively, and moderate correlation was observed with the facial involvement (rho = -0.53; p < 0.01). No correlation was observed between hearing function and HL (rho = -0.09; p = 0.322). In contrast, the aforementioned domain was significantly correlated with complaints of tinnitus (rho = -0.22; p < 0.05). In addition, weak correlations were observed between tinnitus and other domains such as Ax (rho = -0.40; p < 0.01), GH (rho = -0.34; p < 0.01) and En (rho = -0.39; p < 0.01). The correlation between Ba and self-perceived unsteadiness was significant but weak (rho = -0.25; p < 0.01) and the same was observed between the same symptom and Ax (rho = -0.22; p < 0.05).

Criterion-related validity
Significant correlations were reported across DASS21 subscales and PANQOL-It domains. In detail, moderate to strong correlations were observed between Ax and De

Table I. Epidemiological features of the sample.

Variable	Total (n = 124)	Surgery (n = 98)	Conservative (n = 22)	Gamma-Knife (n = 4)	Significance
Gender					
Female	54 (43.5%)	8 (36.4%)	46 (46.9%)	0 (0.0%)	p = 0.135[a]
Male	70 (56.5%)	14 (63.6%)	52 (53.1%)	4 (100.0%)	
Age					
Years	59.65 (12.26; 22-80)	63.00 (11.29; 36-79)	58.57 (12.45; 22-80)	67.50 (7.51; 61-74)	p = 0.132[b]
Tumour size (mm)					
d < 10	16 (12.9%)	10 (45.5%)	6 (6.1%)	0 (0.0%)	**[a]
d = 10-20	52 (41.9%)	12 (54.5%)	36 (36.7%)	4 (100.0%)	
d > 20	56 (45.2%)	0 (0.0%)	56 (57.1%)	0 (0.0%)	
I Koos	16 (12.9%)	10 (45.5%)	6 (6.1%)	0 (0.0%)	**[a]
II Koos	34 (27.4%)	8 (36.4%)	24 (24.5%)	2 (50.0%)	
III Koos	52 (41.9%)	4 (18.2%)	46 (46.9%)	2 (50.0%)	
IV Koos	22 (17.7%)	0 (0.0%)	22 (22.4%)	0 (0.0%)	
Hearing function					
A	36 (29.0%)	6 (27.3%)	28 (28.6%)	2 (50.0%)	p = 0.325[a]
B	16 (12.9%)	2 (9.1%)	14 (14.3%)	0 (0.0%)	
C	46 (37.1%)	12 (54.5%)	32 (32.7%)	2 (50.0%)	
D	26 (21.0%)	2 (9.1%)	24 (24.5%)	0 (0.0%)	
Tinnitus					
Yes	38 (30.6%)	14 (63.6%)	22 (22.4%)	2 (50.0%)	**[a]
No	86 (69.4%)	8 (36.4%)	76 (77.6%)	2 (50.0%)	
Unsteadiness					
Yes	68 (54.8%)	10 (45.5%)	44 (44.9%)	2 (50.0%)	*[a]
No	56 (45.2%)	12 (54.5%)	54 (55.1%)	2 (50.0%)	
Facial involvement					
I HB	44 (35.5%)	20 (90.9%)	20 (20.4%)	4 (100.0%)	**[a]
II HB	26 (21.0%)	2 (9.1%)	26 (26.5%)	0 (0.0%)	
III HB	24 (19.4%)	0 (0.0%)	22 (22.4%)	0 (0.0%)	
IV HB	22 (17.7%)	0 (0.0%)	22 (22.4%)	0 (0.0%)	
V HB	6 (4.8%)	0 (0.0%)	6 (6.1%)	0 (0.0%)	
VI HB	2 (1.6%)	0 (0.0%)	2 (2.0%)	0 (0.0%)	

[a]Chi-square, [b]ANOVA test, * p value < 0.05, ** p value < 0.01.
HB: House-Brackmann grading system; d: maximum diameter. Hearing Function according to the American Academy of Otolaryngology – Head and Neck Surgery Foundation classification [13].

Table II. Correlations between PANQOL-It domain scores.

	Balance	Hearing loss	Facial dysfunction	Energy	General health	Anxiety	Pain
Balance	1.00						
Hearing loss	0.32**	1.00					
Facial dysfunction	0.31**	0.38**	1.00				
Energy	0.54**	0.51**	0.50**	1.00			
General health	0.41**	0.35**	0.25**	0.54**	1.00		
Anxiety	0.48**	0.48**	0.24**	0.61**	0.57**	1.00	
Pain	0.24**	0.29**	0.20*	0.23**	0.13	0.37**	1.00
Total score	0.65**	0.68**	0.58**	0.80**	0.68**	0.78**	0.54**

* p value < 0.05, ** p value < 0.01.

Table III. PANQOL-It reliability.

	Cronbach's alpha coefficient	"Cronbach's alpha if item is deleted"	Item deleted	Floor effect	Ceiling effect	ICC (95 % CI)
Balance	0.90	0.92	9	0.0%	17.7%	0.79 (0.63-0.88)**
Hearing loss	0.77	-	-	1.6%	8.1%	0.72 (0.51-0.84)**
Facial dysfunction	0.49	0.66	11	0.0%	24.2%	0.56 (0.24-0.75)**
Energy	0.79	0.83	21	0.0%	12.9%	0.42 (-0.01-0.67)*
General health	0.44	-	-	4.8%	3.2%	0.43 (0.01-0.67)*
Anxiety	0.88	-	-	1.6%	37.1%	0.90 (0.83-0.94)**
Pain	NA	NA	NA	9.7%	45.7%	0.94 (0.89-0.96)**
Total score	0.92	-	-	0.0%	0.0%	0.77 (0.59-0.87)**

*p value < 0.05, ** p value < 0.01.
NA: not applicable; ICC: Intraclass Correlation Coefficient; IC: confidence interval.

(rho = -0.63; $p < 0.01$), Anxiety (rho = -0.59; $p < 0.01$), Stress (rho = -0.55; $p < 0.01$), between GH and Depression (rho = -0.56; $p < 0.01$), Anxiety (rho = -0.51; $p < 0.01$), and between En and Depression (rho = -0.60; $p < 0.01$), Anxiety (rho = -0.47; $p < 0.01$), Stress (rho = - 0.51; $p < 0.01$). In addition, moderate to strong correlations were observed also between WHODAS II-D1 and GH (rho = -0.44; $p < 0.01$) and En (rho = -0.60; $p < 0.01$).

Discussion

The objective of the current study was to validate the PANQOL into the Italian language. For this purpose, the permission by the original authors was obtained and international standards established by IQOLA were adopted. The instrument was translated using the iterative translation process and psychometric properties were subsequently assessed by administering PANQOL-It to 124 outpatients. The number of subjects recruited was in accordance with the original article and other validation studies [5-9]. Only patients in follow-up for VS or who underwent surgery or stereotactic radiosurgery at least six months before recruitment were considered. This was crucial for two reasons: only stable patients were taken into account and the sample

was representative of all subjects suffering from or treated for VS. Since the first six months of time after diagnosis is associated with poor quality of life, especially with regards to anxiety, considering only patients at least six months after treatment may provide the benefit of assessing patients with a stable quality of life [20]. Three groups were identified according to the treatment and, even if no significant differences in age, gender, and hearing function were observed among the three groups, they were significantly different with relation to tumour size, facial involvement, tinnitus and self-perceived unsteadiness. This result was similar to the results obtained by McLaughlin et al. [21]. Since the objective was not to examine the quality of life across treatment groups, it was not a limitation in the current study.

The means and standard deviations of PANQOL-It domains in the sample yielded similar results to the original study and other validation studies, with the exception of GH (Tab. IV).

Responses to this dimension were smaller in the present study, reflecting worse self-perceived general health. In addition, for FD, En, Pa and the total score the results were slightly smaller. This may be regarded as a limitation because, according to item response theory, the equivalence of

Table IV. Means and standard deviations of PANQOL domains in the current study and those in the original article and other validation studies.

	Original version [5]	Dutch version [6]	Spanish version [7]	French version [8]	Japanese version [9]	Current study
Balance	72.9 (20.5)	66.0 (29.4)	68.36 (29.57)	62.8 (28.2)	86 (18)	69.2 (27.8)
Hearing loss	63.8 (22.2)	41.3 (27.3)	66.43 (28.33)	57.2 (25.3)	72 (22)	54.6 (26.2)
Facial dysfunction	85.4 (18.9)	83.6 (21.3)	75.30 (24.29)	84.2 (15.4)	92 (14)	70.5 (24.8)
Energy	67.6 (23.0)	66.2 (28.9)	66.97 (28.79)	69.3 (25.7)	79 (20)	63.2 (27.8)
General health	68.3 (21.3)	60.4 (22.1)	53.24 (15.73)	59.7 (19.9)	59 (18)	44.8 (27.5)
Anxiety	73.5 (20.4)	71.3 (25.2)	80.09 (29.57)	72.4 (23.2)	83 (19)	76.6 (26.7)
Pain	77.7 (28.7)	70.4 (35.9)	74.07 (35.0)	78.9 (32.6)	80 (25)	68.2 (35.8)
Total score	72.8 (15.6)	69 (21)	69.2 (20.8)	-	79 (14)	63.9 (19.1)

translations is supported when items in different languages are placed similarly on the scale [14]. Nevertheless, more than acceptable reliability was demonstrated for the PANQOL-It. With the exception between Pa and GH, weak to moderate significant correlations were observed across PANQOL-It domains, while all dimensions showed moderate to strong correlations with the total score. The internal consistency of PANQOL-It was compared with the internal consistency of PANQOL and the Dutch, Spanish, French and Japanese versions [6-9]. Since the total score is the average of the seven subscales, the internal consistency was also assessed by calculating Cronbach's alpha coefficient for each domain separately. The alpha was good for Ba and Ax, and acceptable for HL and En (Tab. V). A coefficient of less than 0.7 was obtained for GH according to the Dutch, French and Japanese versions and for FD according to the French version. The poor reliability obtained for those two dimensions could be explained by the small number of items that composed them, since GH and FD are composed of two and three items, respectively. Moreover, in contrast with the original study and other validation studies, in the current study a large proportion of patients with facial involvement was observed [5-8]. In fact, in the original article only 18 of 143 subjects presented a facial involvement with HB more than I, while in the Dutch, Spanish and French studies two, one and no patients with facial involvement were observed, respectively. On the other hand, in the current study 8 patients (6.4%) presented a severe facial involvement or a total facial paralysis. Finally, Cronbach's alpha was not applicable to Pa because it is a single-element domain. Therefore, FD, GH and Pa represented the main drawbacks of PANQOL-It. Nonetheless, since Cronbach's alpha coefficient of the total score was 0.92 and coefficients of each domain were within the range of other validation studies, the internal consistency resulted excellent for the entire instrument and more than acceptable for each domain (Fig. 3). Even if the removal of items 9, 11 and 21 from Ba, FD and En improved the alpha coefficient of the respective domains, the removal of the aforementioned items
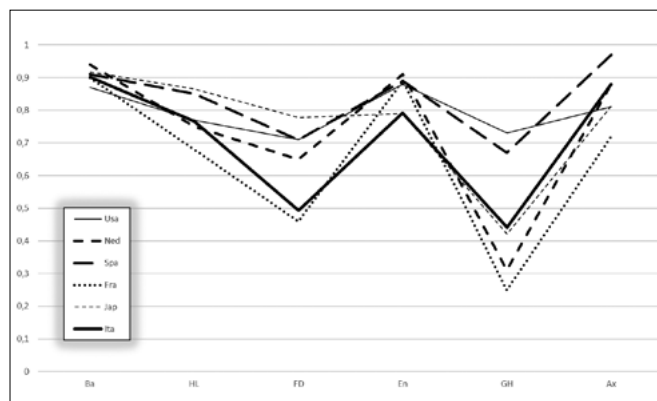
Figure 3. Internal consistency of PANQOL domains in different versions of the instrument.
Usa: original version of PANQOL [5]; Ned: Dutch version [6]; Spa: Spanish version [7]; Fra: French version [8]; Jap: Japanese version [9]; Ita: Italian version of the Penn Acoustic Neuroma Quality of Life Scale (PANQOL-It); Ba: balance domain; HL: hearing loss domain; FD: facial dysfunction domain; En: energy domain; GH: general health domain; Ax: anxiety domain; Pa: pain domain.

did not improve the alpha of the entire instruments. Thus, we decided to remove none of them. No floor effect was observed for PANQOL-It and its domains whereas a ceiling effect was reported in Pa, GH, Ba and Ax. It was also observed in the original article for the same dimensions. Although it is predictable for Pa and GH, since those domains are composed of one and two items, respectively, it should be considered a slight limit. In particular, this could lead to a difficulty in distinguishing patients with the highest possible scores in these domains. The test-retest reliability was used to measure the reproducibility of the instrument. It was adequate since a significant ICC between the scores of PANQOL-It and its domains was observed. In the original article, the authors reported no meaningful correlations with tumour size and audiometric data. The same was observed in the current study, since significant but very weak correlations were seen only between FD and tumour size and between HL and hearing function. In contrast, moderate correlation was observed

Table V. Internal consistency (Cronbach's alpha) of PANQOL domains in the current study and those in the original article and other validation studies.

	Original version [5]	Dutch version [6]	Spanish version [7]	French version [8]	Japanese version [9]	Current study
Balance	0.87	0.94	0.91	0.90	0.92	0.90
Hearing loss	0.77	0.75	0.85	0.68	0.87	0.77
Facial dysfunction	0.71	0.65	0.67	0.46	0.78	0.49
Energy	0.88	0.91	0.89	0.89	0.79	0.79
General health	0.73	0.31	0.67	0.25	0.42	0.44
Anxiety	0.81	0.88	0.97	0.72	0.81	0.88
Pain	NA	NA	NA	NA	NA	NA
Total score	-	-	0.87	-	0.93	0.92

between facial involvement and facial domain, which was consistent with the original article. Significant but weak correlations were also observed between Ba and self-perceived unsteadiness, whereas weak to moderate correlations were reported between complaints of tinnitus and HL, Ax, GH and En, in accordance with the previous study by Kojima et al. [3] They observed that tinnitus severity was the strongest predictor of quality of life in patients with VS managed with a wait and see policy. In particular, it significantly correlated with hearing impairment, anxiety and depression, whereas unsteadiness and hearing impairment had significant but less impact on quality of life. Moderate to strong significant correlations were observed between all subscales of DASS21 and Ax and En, and between Depression and Anxiety of DASS21 and GH. Those results were predictable since many items of PANQOL derived from the Hospital Anxiety and Depression Scale, a reliable and valid screening instrument for anxiety and depression intended for the hospital medical outpatient clinical setting [22]. The inclusion of psychosocial dimensions regarding anxiety, energy and general health represents an absolutely helpful feature for clinicians since it allows for wider inferences to be made using the instrument. Moreover, since anxiety or depression are frequent problems in patients suffering for VS, it is important to assess these specific dimensions. In fact, Pruijn and colleagues observed that anxiety and lack of energy were key factors and two of the strongest predictors affecting and reducing the physical and mental quality of life [23]. In addition, moderate to strong correlations were observed between WHODAS II-D1 and GH and En. The former is the cognition domain of an instrument aimed at measuring behavioural limitations and restrictions to participation experienced by an individual. It evaluates understanding and communicating and results observed suggest a moderate to strong relationship to GH and En dimensions and the social functioning. Finally, only one aspect should be considered. Headache and any other symptoms that the patient might experience which were not asked for in the questionnaire could influence the quality of life [23]. In addition, Bender et al., administering different questionnaires to patients before surgery and at the first follow-up, observed a significantly worse quality of life in depressed patients both before and after surgery [24]. Thus, the existence of a disease-specific quality of life instrument such as PANQOL does not preclude the concomitant use of generic instruments for assessing quality of life. The latter provide broader comparisons and prevent potential confusion due to psychological factors, whereas the former are typically more responsive to change and provide more relevant information to clinicians [25]. Of course, in the research application the contextual use of both types of instruments is recommended.

Conclusions

In the current study, we translated and validated the Italian version of the PANQOL (PANQOL-It). While the sample showed smaller values in the seven dimensions and in the total score compared to the original article and other validations studies, the instrument presented more than acceptable psychometric properties. Cronbach's alpha coefficient resulted excellent for the entire instrument and was consistent for each domain with the original article and other validation studies. Therefore, its adoption is justified for both clinical and research purposes for Italian-speaking subjects. In order to properly interpret the results, clinicians need to be aware that the direction of the score is different for item 25, the only one for which the answer should be counted not inversely.

Author contributions
EA: investigation, data curation, statistical analysis, visualisation, writing – original draft; FM: conceptualisation, data curation; CG: investigation, data curation; LS: resources, supervision; DM: conceptualisation, methodology, project administration, supervision, statistical analysis, resources; SP: supervision, writing – review & editing; RN: validation, visualisation, writing – review & editing.

Ethical consideration
The study was approved by the local Ethic Committee (Protocol AOU 0019113/19 of 3rd July 2019) and was conducted with permission from the authors, received by email on 14th January 2019, to use the original instrument. Writ-

ten informed consent was obtained from each participant and all procedures were in accordance with the ethical standards of the institutional research board and with the 1964 Helsinki declaration and its later amendments.

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Appendix 1. The Italian Version of the Penn Acoustic Neuroma Quality-of-Life scale (PANQOL-It).

	La preghiamo di rispondere a ciascuna delle seguenti domande con un numero da 1 a 5 a seconda del grado di accordo con le affermazioni riportate.	Non sono d'accordo	Non sono molto d'accordo	Non saprei	Sono d'accordo	Sono molto d'accordo
1	La perdita d'udito ha influito negativamente sulle mie relazioni personali	1	2	3	4	5
2	Ho difficoltà a seguire una conversazione a causa della perdita d'udito	1	2	3	4	5
3	Non riesco a concentrarmi quando sento campanelli, fischi o altri rumori	1	2	3	4	5
4	Ho un significativo problema di instabilità	1	2	3	4	5
5	Mi sento instabile o senza equilibrio	1	2	3	4	5
6	Quando cammino o sto in piedi, avverto un senso di rotazione o mi sento cadere	1	2	3	4	5
7	Ho difficoltà a cambiare direzione quando cammino, a causa dei miei problemi di equilibrio	1	2	3	4	5
8	Ho difficoltà a camminare per casa al buio	1	2	3	4	5
9	A causa dei miei problemi di equilibrio, ho paura che gli altri mi credano ubriaco	1	2	3	4	5
10	A causa dell'aspetto della mia faccia, mi comporto in modo strano con le persone	1	2	3	4	5
11	Ho una eccessiva lacrimazione, o provo disagio o prurito ad un occhio	1	2	3	4	5
12	I miei problemi di mimica facciale influiscono negativamente sul mio modo di parlare	1	2	3	4	5
13	A causa del neurinoma dell'acustico, riesco ad avere meno successo di quanto vorrei	1	2	3	4	5
14	Avverto dolore alla testa dal lato del neurinoma dell'acustico	1	2	3	4	5
15	Sono in qualche modo preoccupato del fatto che qualcosa di terribile stia per accadere	1	2	3	4	5
16	Ho spesso brutti pensieri	1	2	3	4	5
17	Mi sento come se fossi rallentato	1	2	3	4	5
18	Ho la sensazione di avere "farfalle nello stomaco"	1	2	3	4	5
19	Mi faccio spesso prendere dal panico	1	2	3	4	5
20	A causa del neurinoma, mi sento spesso isolato	1	2	3	4	5
21	Provo difficoltà a concentrarmi sulle attività quotidiane, come leggere il giornale o guardare la televisione	1	2	3	4	5
22	Sono diventato più impaziente	1	2	3	4	5
23	Ho perso energia o vitalità	1	2	3	4	5
24	Ho difficoltà nel ricordare le cose	1	2	3	4	5
25	Ho una salute eccellente	1	2	3	4	5
26	Ho il timore che il mio stato di salute peggiori negli anni a venire	1	2	3	4	5

The scoring direction differs for item 25, the only one for which the answer should be counted not inversely. Items 4, 5, 6, 7, 8, 9 correspond to the **balance domain (Ba)**, *items 1, 2, 3, 20 correspond to the* **hearing loss domain (HL)**, *item 10, 11, 12 correspond to the* **facial dysfunction domain (FD)**, *items 13, 17, 21, 22, 23, 24 represent the* **energy domain (En)** *and items 25, 26 the* **general health domain (GH),** *whereas items 15,16,18,19 and item 14 rank the magnitude of* **anxiety (Ax)** *and* **pain (Pa)** *domains respectively. The seven scores are calculated on a normalised scale from 0 to 100, since worst to best quality of life experienced. The* **total score (Tot)** *is calculated as the equal average of domain scores.*