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ORIGINAL RESEARCH

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Psychometric properties of the Swedish version of the Glasgow Benefit Inventory in otosclerosis subjects

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Abstract

Objective: To evaluate the psychometric properties of the Swedish version of the Glasgow Benefit Inventory (GBI).

Methods: A prospective multicenter cohort study was conducted. A total of 123 otosclerosis subjects were included in the study. The subjects were divided in three groups based on the following interventions: (a) stapedotomy without any prior hearing-aid rehabilitation (n = 60); (b) hearing-aid rehabilitation without any prior stapedotomy (n = 33); and (c) stapedotomy with prior hearing-aid rehabilitation (n = 30). Pre- and post-operative pure tone audiometry were measured. The Swedish version of the GBI was completed by the subjects 6 months after the intervention. Test-retest reliability and internal consistency, factor analysis, construct validity, and criterion validity, was assessed.

Results: The Swedish version of the GBI was well accepted by the subjects. It showed good psychometric properties with an overall high reliability. Factor analysis resulted in a 5-factor solution explaining 66.6% of the variance where factors 1 and 2 represented the general health domain.

Conclusions: Overall, the Swedish version of the GBI showed good psychometric properties. Based on the factor analyses, there is the possibility that the general health domain should be divided in two separate domains: general health and psychosocial health.

Level of Evidence: 2c.

KEYWORDS

factor analysis, Glasgow Benefit Inventory, otosclerosis, psychometric properties, reliability

1 | INTRODUCTION

Patient-reported outcome measures (PROM) are almost considered mandatory today in the assessment of different medical treatments and conditions. Prior to the development of questionnaires, the results of an intervention were mainly reported as objective measures. In the field of hearing loss and middle-ear surgery, these measures were expressed as air- and bone-conduction thresholds, air-bone gaps, and occasionally speech recognition.[1] Quantitative measurements are of great importance but do not always agree with the experienced disability and benefit of the patients. Earlier studies have indicated that experienced hearing disability correlates more to mental health and the Health-Related Quality of Life (HRQL) than quantitatively measured hearing impairment, thus making PROM important in clinical practice as well as in research.[2,3] Although PROM have been in use in otorhinolaryngology since 1990, a systematic review from 2012 revealed that only 49% of analyzed RCTs had included PROM in the studies and only 10% of these questionnaires had been validated.[4,5] A questionnaire has to be reliable, valid, and easy

to use.[6] Translating and validating existing questionnaires to different languages has been important for enabling the use of validated questionnaires in different populations and countries.

In otorhinolaryngology, a generic postintervention instrument was developed by Robinson, Gatehouse, and Browning in 1996, namely, the Glasgow Benefit Inventory (GBI).[4] The purpose of the GBI was to develop a questionnaire that could be used in different areas of otorhinolaryngology. It has been widely used and particularly in the field of hearing impairment. The questionnaire has been validated and translated to several languages, including Spanish, Arabic, and Portuguese.[7-9] However, a psychometrically validated Swedish version has been missing. The aim of this study was to translate the GBI to Swedish and to evaluate the psychometric properties of the questionnaire for a cohort of otosclerosis subjects undergoing either hearing-aid rehabilitation or stapedotomy.

2 | MATERIALS AND METHODS

This validation study is part of a larger prospective study including subjects with otosclerosis and an intention to be treated, either by hearing-aid amplification or by surgery (stapedotomy). The subjects were identified at six hospitals in Sweden, including three University hospitals and three County hospitals.

The included otosclerosis subjects were divided in three groups based on the intervention: (a) stapedotomy without any prior hearing-aid rehabilitation; (b) hearing-aid rehabilitation without any prior stapedotomy; and (c) stapedotomy with prior hearing-aid rehabilitation. Otosclerosis was defined as conductive hearing loss with an air-bone gap (ABG) ≥ 20 dB and impedance measurements indicating stapes fixation.

One month prior to the intervention and 12 months after the intervention, pure tone audiometry (air- and bone conduction [AC and BC]) was performed. The pure tone average (PTA) for AC and BC was calculated as was the ABG (frequencies 0.5, 1, 2, 4 kHz). Six months after the intervention, the subjects were sent the GBI questionnaire.

A mail-out/mail-back procedure was used. Subjects who did not return the questionnaires within 2 to 3 weeks were reminded once. A test-retest was performed with a subset of subjects (n = 15) who longitudinally completed the questionnaires within 3 weeks after the time of the prior questionnaires.

All included subjects signed a written informed consent before entering the study.

2.1 | Ethical considerations

The study was approved by the Regional Ethical Review Board in Gothenburg, Sweden. Written consent was obtained from all included subjects. All procedures performed in the study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

2.2 | Glasgow Benefit Inventory (GBI)

The GBI comprises 18 items and is scored to a total domain and into three subdomains. The subdomains comprise the following: general health (12 items), social support (3 items), and physical health (3 items). The items are answered using a Likert scale with five alternatives (0-5). The domains are then transformed to scores ranging from −100 (the worst) to +100 (the best) where 0 represents no change.

The GBI was translated into Swedish using a formal forward-backward translation method, pretested on patients with otosclerosis, and reviewed by clinicians and patient focus groups according to the process described by international guidelines.[10]

To the original questionnaire, three questions were added concerning satisfaction, and the questions were accordingly calculated into a satisfaction domain.

The questionnaire was pretested in a pilot study on 20 patients with otosclerosis. These patients were selected to represent different ages, sexes, and treatment modalities. After some minor layout changes, no one found the questions difficult to understand, upsetting or disturbing.

2.3 | Statistical analyses

2.3.1 | Validity

Descriptive statistics were calculated with mean values, range, and SD. Fisher's permutation test was used for univariate analyses. Statistical significance was set at $P < .05$, and a two-sided value was used.

Floor and ceiling effects were assessed for all items as well as for the three domains.

A factor analysis was performed using principal component extraction with orthogonal rotation (varimax with Kaiser normalization). The correlations between items and the underlying factors were assessed.

Criterion validity was assessed by correlating the three domains and the total score to pre- and postintervention pure tone audiometry (PTA_4 for best and worst ear). Pearson's correlation coefficient was used for statistical analyses.

2.3.2 | Reliability

Test-retest reliability of the Swedish GBI domains were calculated using intraclass correlation (ICC). Reliability and internal consistency were assessed using Cronbach's α.

3 | RESULTS

One-hundred and twenty-three subjects were included in the study, and 65% were women. All subjects answered the questionnaires at 6 months. A test-retest questionnaire was sent to 15 subjects among whom 60% were women. Ten subjects had undergone stapedotomy and five had received hearing-aid rehabilitation.

TABLE 1 Demographic data

	Numbers	Sex Female (%)	Age at intervention Years (±SD)	PTA_4 (AC) intervention ear dB HL (±SD)	"Other ear" dB HL (±SD)
All	123	65	47 (±11.8)	49 (11.6)	19 (16.0)
Group 1	60	53	47 (±10.6)	49 (11.4)	15 (14.5)
Group 2	33	73	48 (±12.9)	45 (10.7)	14 (10.3)
Group 3	30	79	48 (±11.1)	54 (11.6)	32 (17.3)

Notes: Group 1 = Stapedotomy without any prior intervention. Group 2 = Hearing-aid rehabilitation without prior stapedotomy. Group 3 = Stapedotomy with previous hearing-aid rehabilitation prior to intervention.

TABLE 2 Item level descriptive statistics grouped by the GBI items

GBI Items (domain)	All	Group 1	Group 2	Group 3
1. Affected things you do (GH)	4.2 (1-5)	4.2 (2-5)	4.0 (1-5)	4.5 (2-5)
2. Made your overall life better or worse (GH)	4.3 (1-5)	4.2 (1-5)	4.1 (2-5)	4.6 (1-5)
3. Optimistic about the future (GH)	3.6 (2-5)	3.6 (2-5)	3.2 (2-4)	4.0 (2-5)
4. Embarrassed when with a group (GH)	3.5 (1-5)	3.5 (2-5)	3.1 (1-5)	3.9 (2-5)
5. Self-confidence (GH)	3.2 (1-5)	3.4 (3-5)	3.0 (2-4)	3.2 (1-5)
6. Deal with company (GH)	3.6 (1-5)	3.7 (3-5)	3.4 (2-5)	3.7 (1-5)
7. Support from your friends (SS)	3.1 (1-5)	3.0 (2-5)	3.2 (3-5)	3.0 (2-5)
8. Been to family doctor (PH)	3.0 (2-5)	3.0 (2-5)	3.1 (3-5)	3.0 (2-5)
9. Confident about job opportunities (GH)	3.3 (1-5)	3.3 (2-5)	3.3 (2-4)	3.4 (1-5)
10. Feel self-conscious (GH)	3.3 (2-5)	3.4 (2-5)	3.2 (2-5)	3.3 (2-5)
11. People care about you (SS)	3.0 (2-4)	3.0 (3-3)	3.0 (3-4)	2.8 (2-3)
12. Catch colds or infections (PH)	2.9 (2-5)	3.0 (2-5)	3.0 (2-3)	2.8 (2-3)
13. Take medicine (PH)	2.9 (1-4)	3.0 (1-3)	2.9 (2-3)	2.8 (2-4)
14. Feel about yourself (GH)	3.5 (2-5)	3.5 (2-5)	3.2 (2-5)	3.7 (1-5)
15. Support from family (SS)	3.2 (2-5)	3.2 (2-5)	3.3 (3-5)	3.2 (2-5)
16. Inconvenienced (GH)	4.1 (2-5)	4.2 (2-5)	3.7 (2-5)	4.1 (3-5)
17. Participate in social activities (GH)	3.2 (1-5)	3.2 (2-5)	3.2 (1-5)	3.1 (1-5)
18. Withdraw from social situations (GH)	3.3 (2-5)	3.3 (2-5)	3.1 (2-5)	3.4 (2-5)
Additional items				
19. Are you satisfied	4.3 (1–5)	4.4 (1-5)	4.2 (1-5)	4.4 (1-5)
20. Family and friends satisfied	4.2 (1-5)	4.2 (1-5)	4.0 (3-5)	4.2 (1-5)
21. Recommend the intervention to a friend	4.5 (1-5)	4.6 (1-5)	4.3 (2-5)	4.6 (3-5)

Notes: Mean scores and range are presented. Likert scale; 1 represents the most negative outcome, 3 no change and 5 the most positive outcome. Domains; GH = general health (12 items), PH = physical health (3 items), SS = social support (3 items).
Abbreviation: GBI, Glasgow Benefit Inventory.

TABLE 3 Domain level descriptive statistics grouped by the GBI domains

GBI domain (n = items)	All	Group 1	Group 2	Group 3
General (12)	29.4 (−41.7-83.3) 26.4	31.4 (−16.7-83.3) 23.8	18.8 (−41.7-66.7) 24.7	36.7 (−33.3-70.8) 29.8
Social support (3)	4.3 (−50.0-66.7) 16.8	3.8 (−33.3-50.0) 12.2	9.4 (0.0-66.7) 16.4	0.0 (−50.0-50.0) 22.8
Physical health (3)	−2.4 (−66.7-33.3) 16.4	−1.8 (−66.7-33.3) 16.0	−0.5 (−33.3-33.3) 9.0	−5.4 (−50.0-33.3) 22.1
Total (18)	19.3 (−38.9-66.7) 19.2	21.3 (−100-100) 17.1	14.0 (−30.6-44.4) 16.2	23.6 (38.9-52.8) 24.3
Additional domain				
Satisfaction mean (3)	13.0 (3.0-15.0) 2.3	13.2 (3.0-15.0) 2.4	12.4 (6.0-15.0) 2.1	13.2 (6.0-15.0) 2.3

Notes: Mean scores (range) and SD are presented. Group 1 = Stapedotomy without any prior intervention. Group 2 = Hearing-aid rehabilitation without prior stapedotomy. Group 3 = Stapedotomy with previous hearing-aid rehabilitation prior to intervention.
Abbreviation: GBI, Glasgow Benefit Inventory.

TABLE 4 Factor analysis

GBI Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
1	**0.768**				
2	**0.798**				
3		*0.596*			
4		**0.704**			
5		**0.702**			
6	*0.454*	*0.386*			
7					**0.855**
8			**0.626**		
9		*0.385*		*0.494*	
10		**0.778**			
11			**0.733**		
12			**0.733**		
13			**0.810**		
14	**0.644**				
15					**0.763**
16	**0.636**				
17				**0.784**	
18				**0.777**	

Notes: The correlations between items and the underlying factors were assessed in a factor analysis using principal components extraction with orthogonal rotation. Factors 1 and 2 represented the general health domain and factor 3 the physical health domain with the addition of item 11. Factor 4 represents two items from the general health domain (participating restriction) and factor 5 social support, except item 11.
Bold correlations > 0.5, Italic correlations < 0.5.
Bold correlations ≥ 0.6, Italic correlations < 0.6.

Demographic as well as audiometric data are presented in Table 1. No significant differences were encountered between groups regarding age. Group 3 had significantly worse hearing both in the intervention ear ($P < .0027$), and in the other ear ($P < .001$). Group 1 consisted of more men (47%) than groups 2 (27%, $P < .086$) and 3 (21%, $P < .041$*).

3.1 | Validity

The item level descriptive statistics are listed in Table 2 and the domain descriptive statistics in Table 3.

The first two items (1 and 2) showed a ceiling effect at 51% and 53%, as did the items regarding satisfaction (19, 20, and 21) at 53%, 41%, and 65%, respectively. No floor effects were noted. The domains showed no floor or ceiling effects except for the added domain satisfaction.

The total scores for the GBI were generally positive. Highest values were detected for the general domain and the total score. The social support and physical domains indicated that no major changes were encountered after the intervention. No major differences were detected between the three groups.

Factor analysis resulted in a 5-factor solution explaining 66.6% of the variance. Loading coefficients >0.55 were reached for all items except items 6 and 9. Factors 1 and 2 represented the general health subscale. Factor 3 represented physical health with the addition of item 11. Factor 4 represented questions 17 and 18 (participation restriction). Factor 5 represented the social support domain, except item 11 (Table 4).

TABLE 5 Reliability tests (n = 15)

GBI domain	ICC[a]	Internal consistency reliability [b]	Internal consistency reliability[b]
General health	0.95	0.89	
Social support	0.73	0.55	0.74[c]
Physical health	0.86	0.90	
Total	0.95	0.86	
Satisfaction mean	0.79	0.67	

Abbreviations: GBI, Glasgow Benefit Inventory; ICC, intraclass correlation.
[a]Intraclass correlation coefficient.
[b]Cronbach's alpha.
[c]Item 7 and 15 included in the analysis, item 11 excluded.

Generally, low correlations were detected between pre- and post-intervention pure tone audiometry and GBI. These results were the same for all three analyzed groups.

3.2 | Reliability

Overall ICC and Cronbach's α showed strong to very strong reliability. The only exception was a considerably lower score for the social support domain (0.55). Recalculation of the social support domain excluding item 11 resulted in an improved result (0.74) (Table 5).

4 | DISCUSSION

The aim of the present prospective study was to validate a Swedish version of the GBI. The interventions in the present study were either stapedotomy or hearing-aid rehabilitation in a cohort of otosclerosis subjects.

The questionnaire was well accepted by the subjects. Reliability and repeatability assessed using ICC showed excellent results. Similar results were obtained in the internal consistency assessment calculating Cronbach's α, with the exception of the social support domain. It could be argued that the reason for this was that the social support domain consists of only three items affecting the result. However, when doing a recalculation and excluding item 11, the result improved.

Factor analysis resulted in a 5-factor solution explaining 66.6% of the variance where factors 1 and 2 represented the general health domain indicating that the general health domain could be divided into two domains: psychosocial and general health.

Previous studies have also shown high reliability in concordance with our study. An exception, as in our study, was a lower score for social support.[9] Factor analysis resulted in a five-factor solution in contrast to the three factors originally described by Robinson et al.[4]

The main difference was that the general health domain loaded on two separate factors in this prospective study. Factor 1 included general health issues and factor 2 included psychosocial issues. A similar structure was described by Sanchez-Cuadrado et al in 2015.[8] In the original article and in a review article by Hendry et al, the domain general health was described as containing questions regarding general health as well as questions regarding psychosocial health, and these findings were in concordance with our study.[11] According to the factor analyses, there is the possibility that the general health domain should be divided into two separate domains: general health and psychosocial health. Items 17 and 18 dealt with questions regarding participation restriction and loaded on a separate factor, factor 5. This finding is similar to a result that had been previously described in a validation study by Aldriweesh et al.[7] However, since two items are considered too few to represent a domain, we suggest that these items add to factor 2 covering psychosocial health as in the original study and in accordance with Sanchez-Cuadrado. Items regarding physical health, in addition to item 11, loaded on factor 3 in accordance with earlier studies. However, based on the content and the relationship to the social support questions, we believe item 11 should belong to the social support domain as in the original version of the questionnaire.

A strength of the present study is the prospective design, making the timespan between intervention and questionnaire standardized for the study population. Six months was considered an optimal timespan allowing the effect of the stapedotomy to stabilize and providing enough time to allow subjects to adjust to a newly fitted hearing aid. The study was not a randomized trial between hearing aid and surgery. The design has drawbacks but also advantages, such as the study population in the hearing-aid group were not randomized to receive a hearing aid or being placed on a waiting list for surgery. They had chosen the particular intervention, which in this case was receiving a hearing aid. However, this design could result in a selection bias between the groups, for example, in personality. In the evolving field of PROM, there is a great need for psychometrically tested questionnaires to ensure that they are valid and reliable.

5 | CONCLUSION

The Swedish translated version of the GBI was well accepted by the subjects and showed good psychometric properties. According to the factor analyses, there is the possibility that the general health domain should be divided in two separate domains: general health and psychosocial health. The validated questionnaire is recommended for future clinical research.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

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