The Journal of Laryngology & Otology (2010), ***124***, *835–841*.

doi:10.1017/S0022215110000757

Main Article

Quality of life in patients with untreated age-related hearing loss

H S Chew, S Yeak*

Abstract

Background: Hearing loss commonly affects quality of life in the elderly, yet is often neglected.

Objectives: To investigate the impact of untreated age-related hearing loss on the quality of life of elderly individuals, and to assess the usefulness of quality of life questionnaires as screening tools for significant hearing loss.

Methods: We recruited 80 patients aged 50 years or more with untreated hearing impairment. The Short Form 36 Health Survey and the Hearing Handicap Inventory for the Elderly Screening Version questionnaire were administered.

Results: There was no significant association between severity of hearing impairment and Short Form 36 Health Survey scores. However, dose-graded correlation was observed between severity of hearing loss and Hearing Handicap Inventory for the Elderly Screening Version questionnaire scores ($p < 0.001$). A score for the latter questionnaire of more than 8 was 72.8 per cent sensitive and 71.4 per cent specific in detecting clinically significant hearing loss of at least 40 dB (receiver operating characteristic = 0.83).

Conclusion: The Short Form 36 Health Survey, a generic measure, lacked specificity and sensitivity in detecting clinically significant hearing loss. However, significant hearing impairment was reflected in the Hearing Handicap Inventory for the Elderly Screening Version questionnaire scores, suggesting that this is a good, disease-specific screening tool. A combination of functional (i.e. the Hearing Handicap Inventory for the Elderly Screening Version questionnaire) and physiological (i.e. audiometric) assessment is recommended to investigate hearing loss in elderly individuals.

Key words: Hearing Loss; Elderly; Quality Of Life

Introduction

Hearing loss is the third most prevalent chronic condition in older adults,[1] with a reported prevalence of up to 83 per cent.[2] Studies have reported that hearing loss may cause poor communication,[3–6] social withdrawal and isolation,[7–10] depression,[8,11–13] dementia,[13,14] decreased functional status,[6] and other maladaptive behaviour.[4] Despite this, many elderly individuals are not assessed or treated for their hearing loss.[15–17] The importance of this omission needs to be studied, especially in the light of our ageing population and the adverse physical and psychosocial impact that hearing loss may have on affected individuals.

Efforts to quantify the impact of hearing loss range from audiometric measurements, through clinical tests such as the whisper test and tuning fork tests, to self-reported quality of life (QoL) questionnaires. Quality of life is a broad, multidimensional concept best assessed by both objective and subjective measurements,[5] and is a subject of great interest and significance. Few studies have investigated the effect of age-related hearing loss on QoL,[17,18] especially in Asian populations. Quality of life measures may assist documentation of the burden of chronic conditions and enable evaluation of health changes and post-interventional effects, and hence assist the allocation of public health resources.

Our study used the Short Form 36 Health Survey, a well validated, generic, health-related QoL measure widely used across different disciplines. We also used the Hearing Handicap Inventory for the Elderly Screening Version questionnaire, a hearing-specific questionnaire.

Our study aimed: (1) to investigate the impact of untreated age-related hearing loss on older individuals' QoL, using both generic and disease-specific research instruments; and (2) to determine the usefulness of QoL questionnaires and audiometry for guiding future interventional strategies.

From the Yong Loo Ling School of Medicine, National University of Singapore, and the *Department of Otorhinolaryngology, Tan Tock Seng Hospital, Singapore.
Accepted for publication: 18 January 2009. First published online 20 April 2010.

Materials and methods

Study population

This was a cross-sectional study conducted over two months. Eighty patients aged 50 years and over with untreated hearing impairment were recruited consecutively from the audiology clinic. Informed consent was obtained. Patients selected for the study were chosen by criteria that excluded: hearing aid use; hearing impairment secondary to otological disease, ototoxicity or noise; congenital or early onset hearing loss; and the presence of psychiatric disorders or dementia.

Audiometric assessment

Hearing examination involved pure tone air and bone conduction audiometric assessment, conducted in a soundproof room by a trained audiologist using a regularly calibrated audiometer. Masking was done where necessary. Hearing impairment was defined as the pure tone average (PTA) of air conduction hearing thresholds >25 dB HL for four frequencies (0.5 to 4.0 kHz) in the better ear. These criteria were chosen on the basis of their impact on the functional aspects of hearing.[18] The American Speech Language Hearing Association classification of hearing loss was applied, i.e.: mild = 26–40 dB HL; moderate = 41–55 dB HL; moderately severe = 56–70 dB HL; and severe to profound = ≥71 dB HL.[19] Twenty patients were recruited from each category of hearing loss.

Quality of life assessment

Two questionnaires were used: the Short Form 36 Health Survey and the Hearing Handicap Inventory for the Elderly Screening Version. Both were administered by one of the authors. Verbal translations of the questionnaires were used for non-English speaking subjects.

Short Form 36 Health Survey. This questionnaire served as a generic measure of health-related QoL. It is a well validated, multipurpose survey comprising 36 questions on QoL. It generates an eight-domain profile of functional health and well-being scores, covering: physical role functioning, role physical, bodily pain, general health perception, vitality, social functioning, emotional role functioning and mental health. Each of these eight domains is graded on a 100-point scale, with a higher score indicating better health. These eight domains are summarised into two summary scores – the physical component score and mental component score – by assigning weights to the individual subscales, as described by the survey's authors. The Short Form 36 Health Survey has been shown to be suitable for use in elderly populations.[20]

Hearing Handicap Inventory for the Elderly Screening Version questionnaire. This served as a disease-specific research tool. It was developed specifically for use within an elderly population, to screen for self-assessed hearing handicap.[10] Many studies have shown the significant audiometric correlates and test–retest reliability of this tool.[15,21,22] It comprises 10 standardised questions, five of which relate to emotions and five to social situations. A response of 'yes' gains 4 points, 'sometimes' 2 points and 'no' 0 points. Scores for this questionnaire range from 0 (no handicap) to 40 (maximum handicap). A cut-off score of more than 8 has commonly been used to indicate the presence of at least mild hearing handicap.[16]

Statistical analysis

Data analysis was conducted using Stata version 10.2 software (Stata, College Station, Texas, USA). The level of significance was set at 5 per cent. For the Short Form 36 Health Survey individual domains, physical component score and mental component score, and the Hearing Handicap Inventory for the Elderly Screening Version questionnaire total score, we used the ordinary least squares linear regression model to examine factors associated with each outcome. We performed both univariate and multivariate analyses, with the latter done to examine adjusted mean difference between the hearing loss groups. Variables included in the multivariate analysis were based on clinical judgment, and included degree of hearing loss, medical conditions and gender. As 40 dB HL is often employed as the threshold for screening and audiometry,[16] we used 40 dB HL as the criterion standard to adjudicate clinically significant hearing loss. Receiver operating characteristic curve analysis was applied to evaluate the sensitivity and specificity of different cut-off scores for the Hearing Handicap Inventory for the Elderly Screening Version questionnaire, in order to find the most appropriate cut-off score to indicate hearing loss of at least 40 dB HL. We also grouped Hearing Handicap Inventory for the Elderly Screening Version questionnaire scores as dichotomous variables (>8 versus ≤8) to indicate hearing handicap, and used the binary logistic regression model to examine factors associated with the outcome. Once again, both univariate and multivariate analyses were performed, with the latter including variables deemed to be clinically relevant.

Results and analysis

Study population characteristics

Subjects comprised 33 (41 per cent) men and 47 (59 per cent) women. Their median age was 69 years (interquartile range: 59–77). Fifty-six (70 per cent) were married, while the remaining 24 (30 per cent) were single, divorced or widowed. The majority (58.8 per cent) had obtained only primary or lower secondary education. Sixty (75 per cent) reported the presence of other, concurrent medical conditions.

The hearing loss observed was predominantly bilateral, symmetrical, high frequency loss. The median hearing loss for the right ear was 61.25 dB HL (interquartile range: 41.25–74.38) and for left ear 63.75 dB HL (interquartile range: 41.88–73.75). The median hearing loss of the better ear used in

https://doi.org/10.1017/S0022215110000757 Published online by Cambridge University Press

our study was 55 dB HL (interquartile range: 33.75–70). There was no significant difference in male:female ratio, comparing the different hearing loss groups ($p = 0.90$). Other medical conditions were equally prevalent amongst the genders ($p = 0.69$) and amongst the different hearing loss groups ($p = 0.91$).

Self-reported quality of life and hearing handicap

The medians for the Short Form 36 Health Survey physical component score and mental component score were 42.60 (interquartile range: 30.23–49.70) and 49.42 (interquartile range: 33.68–53.43), respectively. Neither univariate nor multivariate analyses revealed any significant association between the severity of hearing loss on audiometry and the Short Form 36 Health Survey physical component score, mental component score or eight individual domain scores (Table I). However, female gender and the presence of other medical conditions were significantly associated with a lower physical component score (female gender: 7.31 units decrease ($p = 0.005$); presence of other medical conditions: 6.10 units decrease ($p = 0.04$)).

A dose-graded correlation was observed between the severity of hearing loss on audiometry and the self-reported hearing impairment score from the Hearing Handicap Inventory for the Elderly Screening Version questionnaire. Using the category of mild hearing loss as a reference, we observed a 7.54 unit increase in Hearing Handicap Inventory for the Elderly Screening Version questionnaire score in moderate hearing loss subjects ($p = 0.002$), a 9.44 unit increase in moderately severe hearing loss subjects, and a 14 unit increase in severe to profound hearing loss subjects ($p = <0.001$) (Table II). In addition, similar significant positive correlations were noted between the severity of audiometrically determined hearing loss and the emotional and social subscores of the Hearing Handicap Inventory for the Elderly Screening Version questionnaire (Table II).

With regards to individual question responses to the Hearing Handicap Inventory for the Elderly Screening Version questionnaire, more than 50 per cent of subjects experienced 'frustration on talking to family members', 'difficulty when someone speaks in a whisper', 'difficulty on listening to the television (TV) or radio' and 'hearing loss limits or hampers personal or social life' (i.e. they reported 'yes' or 'sometimes' to these questions).

When a Hearing Handicap Inventory for the Elderly Screening Version questionnaire cut-off score of more than 8 was used to denote hearing handicap, 100 per cent of severe to profound hearing loss subjects were categorised as hearing-handicapped, compared with 65 per cent of those in the moderately severe category, 55 per cent of those in the moderate category, and 25 per cent of those in the mild category ($p < 0.001$). Individuals with moderate and moderately severe hearing loss were respectively 3.79 and 5.92 times as likely to report handicap, compared with those with mild hearing loss (Table II). This indicates that hearing handicap was already experienced by some individuals with mild hearing loss, and that the degree of self-reported handicap correlated to the degree of severity of audiologically determined hearing loss. Furthermore, we found significant correlations between the Hearing Handicap Inventory for the Elderly Screening Version questionnaire handicap severity level (no handicap: 0–8; mild to moderate handicap: 10–24; severe handicap: 26–40) and the audiometrically determined hearing loss severity ($p < 0.001$).

The sensitivity, specificity, percentage correctly classified and likelihood ratio at various Hearing Handicap Inventory for the Elderly Screening Version questionnaire cut-off scores are shown in Table III, using 40 dB HL as the criterion standard. A cut-off score of more than 8 yielded 72.8 per cent sensitivity and 71.4 per cent specificity in detecting clinically significant hearing loss of at least 40 dB (receiver operating characteristic = 0.83).

Discussion

Our study found that the Short Form 36 Health Survey, a generic QoL measure, lacked sensitivity and specificity in assessing the impact of hearing loss on QoL. The recent study by Helvik *et al.*[23] reached similar conclusions; however, these authors utilised a different generic QoL instrument – the Psychological General Well-Being inventory. Other studies have also shown that generic QoL measures lack precision[24,25] and sensitivity to specific effects of hearing loss.[26] In contrast, however, several other studies have reported a significant decrease in the Short Form 36 Health Survey physical component score, mental component score and individual domain scores with increasing hearing loss severity.[3,8,18,27,28] In a study conducted by Newman *et al.*,[29] a significant correlation was present even in subjects with marginal hearing loss.

Studies have shown that women have lower psychosocial well-being than men.[23,30] No conclusive evidence had been given to account for this observation. In the current study, female gender and the presence of other medical conditions were found to be associated with a significantly lower Short Form 36 Health Survey physical component score, even after controlling for other possible confounders in the multivariate analysis. A possible explanation for this is that health problems such as orthopaedic conditions and cardiovascular disease, which often limit physical activity, commonly afflict the elderly, and may result in a decline in physical well-being. Women may have lower physical capacity and endurance, contributing to poorer physical component scores.

However, it must be noted that comparison between different studies is difficult due to differences in population sampling, methodology, hearing loss classification and the QoL instrument employed. Moreover, affected individuals have varying perceptions of hearing loss, and this may be influenced by general life circumstances and events. In addition, one should not ignore the synergistic effect of multiple comorbidity on QoL scores,[3] and individuals' varying ability to cope with their hearing loss. Some studies[3,16,31] have noted a decrease in Short

https://doi.org/10.1017/S0022215110000757 Published online by Cambridge University Press

TABLE I

SHORT FORM 36 HEALTH SURVEY: INDIVIDUAL DIMENSION SCORES AND PHYSICAL AND MENTAL COMPONENT SCORES

Covariable	Domain								PCS	MCS
	Physical functioning	Role, physical	Bodily pain	General health	Vitality	Social functioning	Role, emotional	Mental health		
Hearing loss										
Mild*	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Mod†	−6.50 (−21.33 to 8.33)	8.60 (−16.20 to 33.40)	−4.52 (−21.92 to 12.89)	−0.23 (−11.51 to 11.05)	2.21 (−9.01 to 13.42)	−1.26 (−15.75 to 13.22)	6.45 (−12.50 to 25.42)	−0.26 (−10.40 to 9.87)	−1.24 (−8.28 to 5.80)	1.49 (−4.15 to 7.13)
Mod sev‡	§−15.50 (−30.33 to −0.67)	1.09 (−23.70 to 25.90)	−8.02 (−25.42 to 9.39)	§−13.33 (−24.61 to −2.05)	−5.29 (−16.51 to 5.92)	−8.76 (−23.25 to 5.72)	1.46 (−12.50 to 25.42)	−1.46 (−11.60 to 8.67)	−5.99 (−13.04 to 1.05)	−0.18 (−5.82 to 5.46)
Sev prof**	−10.00 (−24.86 to 4.87)	§28.64 (3.77 to 53.51)	4.36 (−13.09 to 21.81)	−8.29 (−19.60 to 3.02)	1.38 (−9.87 to 12.63)	−9.63 (−23.15 to 5.89)	9.55 (−9.46 to 28.56)	−5.59 (−15.75 to 4.57)	1.50 (−5.57 to 8.56)	−1.78 (−7.43 to 3.88)
Other med conds?										
Yes	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
No	5.00 (−7.15 to 17.14)	§10.11 (−10.20 to 30.42)	9.41 (−4.84 to 23.67)	16.80 (7.56 to 26.03)	§16.09 (6.90 to 25.72)	3.44 (−8.42 to 15.30)	−6.74 (−22.27 to 8.79)	5.66 (−2.64 to 13.96)	§6.10 (0.33 to 11.87)	1.97 (−2.65 to 6.59)
Gender										
Male	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Female	−15.08 (−25.76 to −4.39)	§−17.96 (−35.83 to −0.09)	−16.96 (−29.50 to −4.42)	−6.74 (−14.87 to 1.39)	§−9.79 (−17.87 to −1.70)	−9.34 (−19.77 to 1.10)	−10.92 (−24.59 to 2.73)	§−7.55 (−14.85 to −0.24)	§−7.31 (−12.39 to −2.24)	−3.32 (−7.39 to 0.74)

Data represent multivariate adjusted medians (95 per cent confidence intervals). *26–40 dB HL; †41–55 dB HL; ‡56–70 dB HL; ** > 70 dB HL. §$p \leq 0.05$. PCS = physical component score; MCS = mental component score; ref = reference; mod = moderate; mod sev = moderately severe; sev prof = severe to profound; med conds = medical conditions

TABLE II

HEARING HANDICAP INVENTORY FOR THE ELDERLY SCREENING VERSION QUESTIONNAIRE SCORES: TOTAL SCORE, EMOTIONAL SUBSCORE, SOCIAL SUBSCORE AND ODDS RATIO FOR TOTAL SCORE >8

Covariable	Total score	Emotional subscore	Social subscore	Total score >8 (OR (95% CI))
Hearing loss				
Mild*	Ref	Ref	Ref	Ref
Mod†	7.45 (2.77–12.32)‡	3.12 (0.06–6.19)‡	4.42 (2.14–6.69)**	3.67 (0.96–14.03)
Mod sev§	9.44 (4.67–14.22)**	3.02 (−0.04 to 6.09)‡	6.42 (4.14–8.69)**	5.92 (1.42–21.86)‡
Sev prof#	14.00 (9.21–18.79)**	6.25 (3.18–9.33)**	7.74 (5.46–10.02)**	NC
Other med conds?				
Yes	Ref	Ref	Ref	Ref
No	5.73 (1.82–9.64)‡	3.48 (0.97–5.99)	2.25 (0.39–4.11)‡	3.76 (0.92–15.42)
Gender				
Male	Ref	Ref	Ref	Ref
Female	2.57 (−0.87 to 6.01)	1.94 (−0.27 to 4.14)	0.63 (−1.01 to 2.27)	1.07 (0.92–15.42)

Data represent multivariate adjusted medians (95% confidence intervals (CIs)) unless otherwise specified. *26–40 dB HL; †41–55 dB HL; §56–70 dB HL; #>70 dB HL. ‡$0.001 < p < 0.05$; **$p < 0.001$. OR = odds ratio; ref = reference; mod = moderate; mod sev = moderately severe; sev prof = severe to profound; NC = not calculable; med conds = medical conditions

TABLE III

SENSITIVITY, SPECIFICITY AND CORRECT CLASSIFICATION RATE FOR VARIOUS HEARING HANDICAP INVENTORY FOR THE ELDERLY SCREENING VERSION QUESTIONNAIRE CUT-OFF SCORES*

Cut-off	Sens (%)	Spec (%)	Correct class (%)	LR +	LR −
≥0	100.00	0.00	73.75	1.000	
≥2	96.61	33.33	80.00	1.4492	0.1017
≥4	96.61	52.38	85.00	2.0288	0.0647
≥6	91.53	66.67	85.00	2.7458	0.1271
≥8	89.83	66.67	83.75	2.6969	0.1525
≥10	72.88	71.43	72.50	2.5508	0.3797
≥12	64.41	80.95	68.75	3.3814	0.4397
≥14	55.93	90.48	65.00	5.8729	0.4871
≥16	44.07	95.24	57.50	9.2542	0.5873
≥20	37.29	95.24	52.50	7.8305	0.6585
≥22	30.51	95.24	47.50	6.4068	0.7297
≥24	27.12	95.24	45.00	5.6949	0.7653
≥26	20.34	95.24	40.00	4.2712	0.8364
≥28	13.56	95.24	35.00	2.8475	0.9076
≥30	5.08	95.24	28.75	1.0678	0.9966
≥38	1.69	100.00	27.50		0.9831
>38	0.00	100.00	26.25		1.000

Receiver operating characteristic area = 0.8329; standard error = 0.057; 95% confidence interval = 0.72–0.95. *Using 40 dB HL as the standard criterion for hearing loss. Sens = sensitivity; spec = specificity; class = classification; LR + = positive likelihood ratio; LR − =negative likelihood ratio

Form 36 Health Survey physical component score with increasing severity of hearing loss; this may be attributable to the general health decline in the elderly (but may not have been adjusted for in these studies' analyses). Hence, there is an indirect relationship between the degree of hearing loss and the general well-being of affected elderly individuals.

On the other hand, our results for the Hearing Handicap Inventory for the Elderly Screening Version questionnaire showed a highly significant correlation between severity of hearing impairment and the degree of hearing handicap reported by subjects. This is consistent with other studies' findings.[15,16,18] In age-related hearing loss, loss of high frequency hearing results in poor speech perception, as the perception of consonants (which give clarity to speech) is affected.[8,13,23] In our series, such poor speech perception may have accounted for subjects' communication difficulties, which may in turn have had a negative impact on their emotional and social well-being (Table II). Subjects reported problems when listening to TV and radio (61.2 per cent) and listening to whispered speech (75 per cent), and they experienced frustration when talking to family members (58.7 per cent). Similarly, another study reported 50 per cent impairment in these areas.[32]

- **Hearing loss commonly affects elderly individuals' quality of life (QoL), yet is often neglected**
- **This study investigated the impact of untreated age-related hearing loss on elderly subjects' QoL, and also assessed the usefulness of QoL questionnaires as screening tools for the presence of significant hearing loss**
- **The Short Form 36 Health Survey and the Hearing Handicap Inventory for the Elderly Screening Version questionnaire were used to assess older subjects with untreated hearing impairment**
- **The former questionnaire, a generic measure, lacked specificity and sensitivity; however, the latter questionnaire detected significant hearing impairment, suggesting its possible use for hearing loss screening**

It can therefore be inferred that untreated hearing loss does result in a significant decline in QoL. However, the perception of a hearing handicap (i.e. a response of 'yes' or 'sometimes') was reported by less than half (41.2 per cent) of subjects. This is consistent with Weinstein findings (46 per cent).[32] Explanations for this include subjects' varying perceptions and definitions of hearing handicap, denial of hearing loss in some, and the degree of social and family support received. It is also important to note that hearing loss adversely affects not only the hearing-impaired individual but also the QoL of those around them. The hearing-impaired individual's

https://doi.org/10.1017/S0022215110000757 Published online by Cambridge University Press

frustrations, and some of their adaptive behaviours (e.g. increasing the volume of TV and radio) may disturb those around them. Thus, it may be informative to investigate the impact of hearing loss on the QoL of affected individuals' family members, in order to obtain a more objective picture of the overall impact of hearing loss.

Using 40 dB HL as the standard criterion for clinically significant hearing loss, it was evident that, as the Hearing Handicap Inventory for the Elderly Screening Version questionnaire cut-off score increased, this tool's specificity increased while its sensitivity fell (Table III). A cut-off score of more than 8 provided a good compromise between sensitivity and specificity (giving a sensitivity of 72.88 per cent and a specificity of 71.43 per cent), with 72.50 per cent of subjects correctly classified. Other studies have assessed this cut-off score, and found sensitivity and specificity rates ranging from 0.63 to 0.80 per cent.[33–39] Correlation coefficient $r = 0.33$ ($p < 0.003$).

We found an imperfect relationship between the degree of hearing handicap (as indicated by the Hearing Handicap Inventory for the Elderly Screening Version questionnaire) and the physiological hearing loss (as determined audiometrically). Different individuals may experience different degrees of handicap from the same level of hearing loss. Hence, the psychosocial impact of hearing loss cannot be predicted from audiometric findings alone.[4] The Hearing Handicap Inventory for the Elderly Screening Version questionnaire thus serves as a good screening tool for functional hearing impairment among older adults. This questionnaire may be less sensitive in detecting early hearing loss; however, it identifies individuals who experience handicap from their hearing loss and are thus more likely to agree to, and benefit from, interventional measures (e.g. formal audiological evaluation, referral for hearing aids, and support groups). The Hearing Handicap Inventory for the Elderly Screening Version questionnaire is also easy to administer, and provides a convenient, cheap and practical means of screening for hearing loss, especially among bed-bound and physically debilitated elderly individuals, who may find it difficult to travel to an audiological centre for formal evaluation. This questionnaire can also be used for follow up, to assess QoL improvement post-intervention.

Many studies have emphasised the importance of self-help groups, medical intervention and early rehabilitation in ensuring maximum benefit for hearing-impaired elderly individuals.[32,40,41]

Conclusion

The disease burden of untreated age-related hearing loss may have been neglected due to its invisibility, gradual onset, perceived insignificance compared with other life-threatening conditions, and lack of data on QoL impact. In this study, we have shown that untreated hearing loss in the elderly resulted in a significant decline in QoL, which was reflected in Hearing Handicap Inventory for the Elderly Screening Version questionnaire scores. The Short Form 36 Health Survey, being a generic measure, was less useful in assessing QoL impairment solely attributed to hearing loss.

In view of the increasing prevalence of hearing loss and its significant detrimental impact, we advocate hearing loss screening, creation of support groups, and timely medical intervention (e.g. referral for hearing aids).

The Hearing Handicap Inventory for the Elderly Screening Version questionnaire is a good, disease-specific screening tool for hearing loss. In view of the imperfect relationship between physiological and functional hearing loss, the combined use of both functional (i.e. the Hearing Handicap Inventory for the Elderly Screening Version questionnaire) and physiological (i.e. audiometry) assessment may provide the most holistic evaluation for interventional purposes.

Acknowledgements

The authors would like to thank Mr Arul Ernest (Principal Medical Statistician, Clinical Research Unit, Tan Tock Seng Hospital) and the audiologists of the Department of Audiology, Tan Tock Seng Hospital, for their assistance with this study.

References

1 Low WK. Managing hearing loss in children and adults: Singapore context. *Ann Acad Med Singapore* 2005;**34**:295–300
2 Wu HY, Chin JJ, Tong HM. Screening for hearing impairment in a cohort of elderly patients attending a hospital geriatric medicine service. *Singapore Med J* 2004;**45**:79–84
3 Brink P, Stones M. Examination of the relationship among hearing impairment, linguistic communication, mood, and social engagement of residents in complex continuing-care facilities. *Gerontologist* 2007;**47**:633–41
4 Hallberg LR, Hallberg U, Kramer SE. Self-reported hearing difficulties, communication strategies and psychological general well-being (quality of life) in patients with acquired hearing impairment. *Disabil Rehabil* 2008;**30**:203–12
5 Tsuruoka H, Masuda S, Ukai K, Sakakura Y, Harada T, Majima Y. Hearing impairment and quality of life for the elderly in nursing homes. *Auris Nasus Larynx* 2001;**28**:45–54
6 Strawbridge WJ, Wallhagen MI, Shema SJ, Kaplan GA. Negative consequences of hearing impairment in old age: a longitudinal analysis. *Gerontologist* 2000;**40**:320–6
7 Fellinger J, Holzinger D, Dobner U, Gerich J, Lehner R, Lenz G *et al*. Mental stress and quality of life in a deaf population. *Soc Psychiatry Psychiatr Epidemiol* 2005;**40**:737–42
8 Chia EM, Wang JJ, Rochtchina E, Cumming RR, Newall P, Mitchell P. Hearing impairment and health-related quality of life: the Blue Mountains Hearing Study. *Ear Hear* 2007;**28**:187–95
9 Resnick HE, Fries BE, Verbrugge LM. Windows to their world: the effect of sensory impairments on social engagement and activity time in nursing home residents. *J Gerontol B Psychol Sci Soc Sci* 1997;**52**:S135–44
10 Weinstein BE, Ventry IM. Hearing impairment and social isolation in the elderly. *J Speech Hear Res* 1982;**25**:593–9
11 Cacciatore F, Napoli C, Abete P, Marciano E, Triassi M, Rengo F. Quality of life determinants and hearing function in an elderly population: Osservatorio Geriatrico Campano Study Group. *Gerontology* 1999;**45**:323–8
12 Burrows AB, Morris JN, Simon SE, Hirdes JP, Phillips C. Development of a minimum data set-based depression rating scale for use in nursing homes. *Age Ageing* 2000;**29**:165–72
13 Veras RP, Mattos LC. Audiology and aging: literature review and current horizons. *Braz J Otorhinolaryngol* 2007;**73**:122–8

14 Herbst KG, Humphrey C. Hearing impairment and mental state in the elderly living at home. *Br Med J* 1980;**281**:903–5
15 Jupiter T, DiStasio D. An evaluation of the HHIE-S as a screening tool for the elderly homebound population. *JARA* 1998;**31**:11–21
16 Yueh B, Shapiro N, MacLean CH, Shekelle PG. Screening and management of adult hearing loss in primary care: scientific review. *JAMA* 2003;**289**:1976–85
17 The consequences of untreated hearing loss in older persons. *ORL Head Neck Nurs* 2000;**18**:12–16
18 Dalton DS, Cruickshanks KJ, Klein BE, Klein R, Wiley TL, Nondahl DM. The impact of hearing loss on quality of life in older adults. *Gerontologist* 2003;**43**:661–8
19 Clark JG. Uses and abuses of hearing loss classification. *ASHA* 1981;**23**:493–500
20 Lyons RA, Perry HM, Littlepage BN. Evidence for the validity of the Short-Form 36 Questionnaire (SF-36) in an elderly population. *Age Ageing* 1994;**23**:182–4
21 Jupiter T, Palagonia CL. The Hearing Handicap Inventory for the Elderly screening version adapted for use with elderly Chinese American individuals. *Am J Audiol* 2001;**10**:99–103
22 Bess FH, Lichtenstein MJ, Logan SA, Burger MC. Comparing criteria of hearing impairment in the elderly: a functional approach. *J Speech Hear Res* 1989;**32**:795–802
23 Helvik AS, Jacobsen G, Hallberg LR. Psychological well-being of adults with acquired hearing impairment. *Disabil Rehabil* 2006;**28**:535–45
24 Naess SN. *Quality of life Research. Concepts, Methods and Applications*. Oslo: Institute of Applied Social Research, 1987
25 Nordenfelt L. *Quality of Life and Health, Theory and Critics*. Stockholm (Swedish): Almquist & Wiksell, 1991
26 Bess FH. The role of generic health-related quality of life measures in establishing audiological rehabilitation outcomes. *Ear Hear* 2000;**21**:74–79S
27 Ringdahl A, Grimby A. Severe-profound hearing impairment and health-related quality of life among post-lingual deafened Swedish adults. *Scand Audiol* 2000;**29**:266–75
28 Bess FH, Lichtenstein MJ, Logan SA, Burger MC, Nelson E. Hearing impairment as a determinant of function in the elderly. *J Am Geriatr Soc* 1989;**37**:123–8
29 Newman CW, Jacobson GP, Hug GA, Sandridge SA. Perceived hearing handicap of patients with unilateral or mild hearing loss. *Ann Otol Rhinol Laryngol* 1997;**106**:210–14
30 Moum TNS, Sørensen T, Tambs K, Holmen J. Hypertension labelling, life events and psychological well-being. *Psycholog Med* 1990;**20**:635–46
31 Campbell VA, Crews JE, Moriarty DG, Zack MM, Blackman DK. Surveillance for sensory impairment, activity limitation, and health-related quality of life among older adults – United States, 1993–1997. *MMWR CDC Surveill Summ* 1999;**48**:131–56
32 Weinstein BE. Age-related hearing loss: how to screen for it, and when to intervene. *Geriatrics* 1994;**49**:40–5
33 Ciurlia-Guy E, Cashman M, Lewsen B. Identifying hearing loss and hearing handicap among chronic care elderly people. *Gerontologist* 1993;**33**:644–9
34 Weinstein BE, Ventry IM. Audiometric correlates of the Hearing Handicap Inventory for the elderly. *J Speech Hear Disord* 1983;**48**:379–84
35 Lichtenstein MJ, Bess FH, Logan SA. Validation of screening tools for identifying hearing-impaired elderly in primary care. *JAMA* 1988;**259**:2875–8
36 Lichtenstein MJ, Bess FH, Logan SA. Diagnostic performance of the hearing handicap inventory for the elderly (screening version) against differing definitions of hearing loss. *Ear Hear* 1988;**9**:208–11
37 McBride WS, Mulrow CD, Aguilar C, Tuley MR. Methods for screening for hearing loss in older adults. *Am J Med Sci* 1994;**307**:40–2
38 Mulrow CD, Tuley MR, Aguilar C. Discriminating and responsiveness abilities of two hearing handicap scales. *Ear Hear* 1990;**11**:176–80
39 Hands S. Hearing loss in over-65s: is routine questionnaire screening worthwhile? *J Laryngol Otol* 2000;**114**:661–6
40 Garstecki DC, Erler SF. Older adult performance on the communication profile for the hearing impaired. *J Speech Hear Res* 1996;**39**:28–42
41 Kriscos PB. Audiologic rehabilitation for the elderly: a collaborative approach. *Hear J* 1997;**50**:10–19

Address for correspondence:
Dr Chew Hui Sing,
Department of ENT,
11 Jalan Tan Tock Seng,
Singapore 308433.

Fax: (65) 6357 7749
E-mail: huisingchew@hotmail.com

Dr H S Chew takes responsibility for the integrity of the content of the paper.
Competing interests: None declared