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The impact of auditory attention disorders on the quality of life of elderly people

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ABSTRACT

Introduction: In addition to prolonging the length of life, one of the challenges in modern human life sciences is to improve the quality of life in the elderly, who are often facing numerous crises at their age. Thus, there is a growing interest in studies aimed at analyzing quality of life with a view to identifying the needs of older people and improving the way the elderly function in society.

The aim of the present study is to investigate the characteristics of hearing in elderly people and their views on the relationship between hearing and quality of life. As such, 2 research questions were asked: 1. What is the declared quality of life of older people? 2. Is there a connection between hearing and quality of life?

Materials and methods: The study involved 34 people aged 60–90 years with an average age of 73.77 years. The participants were divided into 2 age groups: early ageing (60–74 years old, 46.4%) and late ageing (75–90 years old, 53.6%). More than half of the respondents (59.3%) were in a diagnosed disability class, of which 31.2% were in the 1st disability class, 50.0% in the 2nd disability class, and 18.8% in the 3rd disability class. None of the respondents were registered in a disability class due to an audtory disability. Only 4 people (14.8%) declared having a hearing aid. The following research methods were used: a diagnostic survey with the use of the Quality of Life Questionnaire by Straś-Romanowska et al., and auditory attention diagnosis with the use of Tomatis® Listening Test System (TLTS).

Results: The results of the study revealed a directly proportional relationship between quality of life and the speech and emotional ranges of sound perception. This means that a loss in air conduction hearing increases significantly with higher levels of global quality of life ($p < 0.03$; $p < 0.005$). In the motor hearing range, an inversely proportional relationship was observed, i.e. sound perception at a lower decibel level can be noted along with higher global quality of life and quality of life in its psychosocial dimension.

Conclusions: The study results confirm the hypothesis that the perceived quality of life among the elderly is generally at a satisfactory level. The greatest changes take place in the psychosocial dimension during early aging and psychophysical dimension during late aging.

Keywords: quality of life; auditory processing disorders; older individuals; aging; hearing loss.

INTRODUCTION

The problem of ageing populations is widely discussed in many European countries. The scale of this issue has become a significant research subject in many branches of medical and social sciences. The main reason for researchers having a growing interest in ageing is the steady increase in the number of elderly people in society.

Between the years 2005–2015, Poland saw the highest rate of population growth in those who were 65 and above: in 2005, they amounted to 13.3% of the population, and in 2015 to 15.8%. The upward trend in the number of elderly people constitutes a significant achievement for civilization but also presents a number of challenges in various spheres of human life (e.g. economic, educational, or social) [1].

One of the challenges of modern human life sciences is, in addition to prolonging life span, improving the quality of life of the elderly who are facing numerous crises at their age. This is why there is a growing interest in researching quality of life with a view to identifying the needs of elderly people. This will help bring about solutions to improve how the elderly function in society [2, 3, 4, 5].

According to Sosnowska, quality of life determines the prospects of successful ageing. It is imperative that factors other than disabilities, such as difficulties and the wide spectrum of problems associated with this stage of human life, are also studied. Sosnowska claims that learning about the psychological aspects that come with ageing deepens our knowledge about old age and its positive determinants. This approach deserves attention because it contradicts the common belief that old age only involves negative aspects. Ageing should be considered from different human dimensions, e.g. biological, psychological and social. These dimensions are closely related as changes in one affect functioning in the others [5]. Boggatz conducted a literature review aimed at identifying the existing definitions of quality of life in old age in order to determine the most appropriate nursing care for the elderly. His literature review resulted in the identification of 3 basic quality of life concepts: satisfactory living conditions, subjective general well-being, and subjective fulfilment of the different dimensions of human life [6].

It can thus be concluded that it is necessary to consider age (especially in older people) in terms of biological, mental,

social security, economic, and social categories. Biological age refers to the degree of overall fitness and vitality of the body, often referred to as the degree of life competency. Biological and medical measurements of how the body functions are the basis for determining biological age. Mental age is determined by the quality of intellectual functions, sensory abilities and human adaptability. Social age is illustrated by the social situation of a person, i.e., his or her place in society and his or her specific roles. Social age also includes categories of economic and social security age, the 1st of which is related to the place occupied by a person in the system of the social division of labor. Social security age, in turn, is connected with the right to pension benefits, i.e., social security on the basis of relevant legal regulations recognizing the period of old age as privileged [7].

A slightly different classification of the dimensions of human life was adopted by Straś-Romanowska (after: Frąckowiak [8]). Her concept also acknowledges the complexity and multidimensionality of human beings, but the dimensions adopted are psychophysical, psychosocial, personal, and metaphysical. The psychophysical dimension is biological well-being (health and fitness), i.e. satisfying biological needs. The personal dimension is self-fulfillment (achieving one's goals and interests) and self-acceptance. The psychosocial dimension is understood as meeting the requirements of the surrounding environment, i.e., maintaining relationships with other people. Finally, the metaphysical dimension is spiritual development and the acceptance of absolute values including the meaning of life [8].

Many quality of life researchers are seeking factors that can make a significant contribution to improving the quality of life of elderly people, in particular, they are focusing on such determinants as mental well-being, positive relationships with other people, personal development opportunities, and physical health.

One component of physical well-being that can interfere with some quality of life dimensions is hearing, which naturally deteriorates with age. Research shows that people over 50 years of age experience various types of conductive and receiving hearing issues, e.g., problems with discrimination of sounds, understanding speech in noise, or localization of sounds. These problems are not immediately revealed in tonal audiometry, which determines hearing loss in frequencies between 0.5–4 kHz. Hearing loss starts with high-frequency hearing problems and progresses with age. Factors increasing hearing loss include exposure to noise, ototoxic drugs, and some diseases. In the population of people over 65 years of age, hearing issues affect about 30% of people [9], in the population over 75 years of age the percentage is twice as high. The most common symptoms of auditory diseases include degenerative changes in the auditory ossicles, impairment of auditory nerve function, cochlear cell atrophy, reduced ability to hear higher sounds, sound differentiation disorders, reduced ability to maintain balance, or wax hardening in the outer ear [10]. Studies on gerbils led to the distinction of 4 audiometric phenotypes [9]: normal – with mild hearing loss at high frequencies; metabolic – with flat hearing loss at low frequencies of 20 db; sensory – with normal hearing at low frequencies and an acute drop in hearing at high frequencies; and mixed – with a deviant audiogram at both low and high frequencies.

Hearing loss undoubtedly affects the quality of life of older people. It makes it difficult to meet new challenges, contributes to a decline in social activity, and lowers quality of life by process. Hearing impairments are stereotypically associated with old age, which means that those who are experiencing hearing loss often hide it and do not take remedial action [11, 12, 13]. Examples of abnormal sound perception include situations where it is difficult for a person to understand a group of speakers, or where there is extra acoustic noise in the environment. Hearing loss at an older age is characterized by the fact that certain important sounds in speech are not perceived clearly. This gives an impression of "I can hear but do not understand".

However, when discussing the problem of hearing, it is worth considering and distinguishing between 2 phenomena related to the hearing process: listening and hearing. According to Knychalska-Zbierańska, it is important that the hearing organ is functional so it can convey auditory information to the brain. However, as she emphasizes, this does not guarantee proper listening [14]. The term "listening" refers to paying attention to sound, i.e., perceiving information. By nature, hearing is passive, while listening is active, i.e., it requires commitment, awareness, and will.

Listening skills consist of both the ability to filter and assimilate information properly. Efficient processing of sensory data eliminates unnecessary stimuli, which enables concentration without the feeling of information overload. Filtered information can be transformed and sorted into significant units. However, if this process is disturbed, listening problems can occur which affect learning skills (significant for children and adolescents) and communication skills. This can lead to behavioral disorders, and even a lack of life energy (important for the elderly). To sum up, hearing is dependent on external stimuli, while listening is related to how a person processes this information. The listener consciously focuses on sound perception and is, therefore, active, interested, and focused [15].

The aim of the present study is to investigate the conditions related to the characteristics of hearing in elderly people and their views on the relationship between hearing and quality of life. As such, 2 research questions were asked:

1. What is the declared quality of life of older people?
2. Is there a connection between hearing and quality of life?

MATERIALS AND METHODS

The study involved 34 people aged 60–90 years with an average age of 73.77 years. The participants were divided into 2 age groups: early ageing (60–74 years old, 46.4%) and late ageing (75–90 years old, 53.6%) [8]. More than half of the respondents (59.3%) were in a diagnosed disability class, of which 31.2% were in the 1st disability class, 50.0% in the 2nd disability class, and 18.8% in the 3rd disability class. None of the respondents were registered within a disability class due to auditory disability. Only 4 people (14.8%) declared having a hearing aid.

The following research methods were used: a diagnostic survey with the use of the Quality of Life Questionnaire by Frąckowiak et al. [8], and auditory attention diagnosis with the use of Tomatis® Listening Test System (TLTS) [16].

Quality of Life Questionnaire

The Quality of Life Questionnaire consists of 60 statements grouped according to 4 dimensions (15 items in each): psychophysical, psychosocial, personal, and metaphysical (spiritual). The psychophysical dimension is defined as biological well-being in terms of health and fitness; the personal dimension is, among others, indulging in one's passion and self-fulfillment; the psychosocial dimension includes relationships with other people and the sense of being needed; and the metaphysical dimension as following one's conscience and acceptance of absolute values. The basis for determining quality of life is the level of satisfaction achieved in these dimensions. Each statement can be evaluated using a 4-step score, which produces a possible range of results 60–240.

As asserted by Frąckowiak, the Quality of Life Questionnaire has been validated and meets the requirements of psychometric goodness, which fully justifies the use of this tool in the present study [8].

Auditory attention diagnostic tests with Tomatis® Listening Test System

The diagnostic tests are carried out by means of an appropriately calibrated audiometer. They are used to identify and assess problems related to the analysis of sounds in 3 ranges of perception: motor (vestibular) – 250, 500, 750, 1000 Hz, speech – 1500, 2000, 3000 Hz, and emotions – 4000, 6000, 8000 Hz. The dominance of the ear responsible for the speed of auditory processing is also assessed. The results are presented in a diagram revealing not only the ear's auditory attention potential, but also all abnormalities in sound perception and analysis.

The auditory attention and laterality test includes the following components:

- air conduction (AC) test (8000–250 Hz),
- bone conduction (BC) test (4000–250 Hz),
- sound selection test (discrimination of sound pitches),
- auditory laterality test (ear dominance).

Procedure

The study was approved by the Bioethics Committee of Poznań University of Medical Sciences (Resolution 408/17). The tests were carried out on patients of 2 different Day Care Home Complexes in Poznań, who provided their consent to participate.

RESULTS

Quality of life

Perceived global quality of life results were divided into 3 levels: low, moderate and high, by converting raw data into T-scales. Detailed data are presented in Table 1.

TABLE 1. Perceived global quality of life

Perceived global quality of life			Aging periods	
			early aging (60–74 years)	late aging (75–88 years)
Level	high	n	3	1
		%	23.1	6.6
	moderate	n	6	10
		%	46.1	66.7
	low	n	4	4
		%	30.8	26.7
Total		n	13	15
		%	100	100

The above data indicate a similar distribution at different levels of global quality of life between the age groups. In most cases (both among the older and younger participants), participants displayed a moderate global quality of life (66.7% and 46.1%, respectively). A smaller percentage of participants declared low and high levels of quality of life (in the group of older people there was only one such declaration).

An analysis of particular dimensions of quality of life was also carried out. In both age groups, no participant declared a high quality of psychophysical life. Comparing results in both groups, a gradual loss of psychophysical quality of life from an average level to a low level can be noted in the psychophysical dimension (Tab. 2).

TABLE 2. Perceived quality of life in the psychophysical dimension

Perceived quality of life Psychophysical dimension			Aging periods	
			early aging (60–74 years)	late aging (75–88 years)
Level	high	n	0	0
		%	0	0
	moderate	n	8	6
		%	61.5	40.0
	low	n	5	9
		%	38.5	60.0
Total		n	13	15
		%	100	100

An interesting distribution of data was found in the personal dimension (self-fulfillment) results. Other than one participant in the older age group, no one declared a high or a low level of quality of life (Tab. 3).

In the psychosocial dimension, more participants in the older group declared a moderate quality of life (80%) than in the younger group (46.2%). The results show that people in the late ageing group had a greater sense of satisfaction in interpersonal relations (Tab. 4).

Results regarding the quality of life in its metaphysical dimension indicate that the older group experienced this at a moderate level, with no one reporting a low level of perceived quality of life (Tab. 5).

TABLE 3. Perceived quality of life in the personal dimension

Perceived quality of life Personal dimension			Aging periods	
			early aging (60–74 years)	late aging (75–88 years)
Level	high	n	0	0
		%	0	0
	moderate	n	13	14
		%	100	93.4
	low	n	0	1
		%	0	6.6
Total		n	13	15
		%	100	100

TABLE 4. Perceived quality of life in the psychosocial dimension

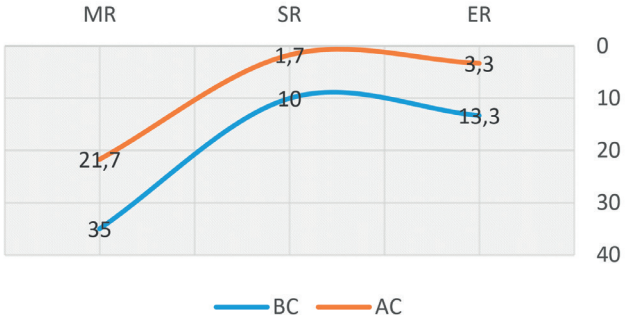
Perceived quality of life Psychosocial dimension			Aging periods	
			early aging (60–74 years)	late aging (75–88 years)
Level	high	n	3	0
		%	23.1	0
	moderate	n	6	12
		%	46.2	80.0
	low	n	4	3
		%	30.7	20.0
Total		n	13	15
		%	100	100

TABLE 5. Perceived quality of life in the metaphysical dimension

Perceived quality of life Metaphysical dimension			Aging periods	
			early aging (60–74 years)	late aging (75–88 years)
Level	high	n	0	0
		%	0	0
	moderate	n	11	15
		%	84.6	100
	low	n	2	0
		%	15.4	0
Total		n	13	15
		%	100	100

Auditory attention test (TLTS)

The ideal curve of auditory processing is determined by the min. level of AC (blue line) and BC (red line). A close to ideal curve indicates the ability to adapt and be ready to receive information. The analysis of central auditory processing is determined by the reception of sounds in 3 ranges of operation (Fig. 1) obtained by averaging the results of the analysis. The range of low-frequency sounds or motor (vestibular) range (MR) spans 250–1000 Hz at a mean AC of 35 dB, and at a mean C of 21.7 dB. The image of the curve in this range indicates motor predispositions such as balance, sense of time and space, and control over one's body. The medium frequency range or speech range (SR) is 1500–3000 Hz and defines one's predispositions to perceiving sounds from speech, understanding and messages at a mean AC of 10 dB and BC of 1.7 dB. The range between 4000–8000 Hz, called the emotions range (ER), defines the operation at the level of emotions, energy to act and stimulation of the cerebral cortex at a mean AC of 13.3 dB and mean BC of 3.3 dB.



MR – motor range; SR – speech range; ER – emotions range; BC – bone conduction; AC – air conduction

FIGURE 1. Normal curve of averaged results of sound perception in 3 ranges for the right and left ear

In the studied sample, the auditory attention analysis did not reveal statistically significant differences between age groups. Therefore, the results of the study are given for the whole group of participants. Non-significant differences were also found in particular hearing ranges for the right and the left ear, hence the results show the lower value of sounds at particular frequencies, e.g., 250, 500, 1000, 1500, 3000, 4000, 6000, 8000 Hz. In each of the hearing ranges (MR, SR, ER), the mean frequency values were given.

Respondents reported sound reception in the MR for AC at 61.0 dB, for BC at 58.1 dB; in the SR for AC at a slightly higher level of 38.3 dB, for BC at 46.3 dB. In the ER for AC, they reported sound reception at 55.8 dB, and for BC at 38.3 dB (Tab. 6).

The difference between normal and actual sound reception is shown in Table 7. The ER has the greatest deficit in sound reception, which for AC reaches 51.6 dB. The smallest difference is for BC – 28.3 dB was noted in the ER.

The results of the study revealed a directly proportional relationship between quality of life and sound perception ability in the SR and ER of sound perception. This means that a loss in AC hearing increases significantly with higher levels of global quality of life ($p < 0.03$; $p < 0.005$). In the motor hearing range, an inversely proportional relationship was observed, i.e. sound perception at a lower decibel level can be noted along with higher global quality of life and quality of life in the psychosocial dimension (Tab. 8).

TABLE 6. Auditory attention test results in particular hearing (sound reception) ranges (dB)

Parameters	Median	Minimum	Maximum	Standard deviation	p*
Air conduction (AC) – motor range (250, 500, 750, 1000 Hz)					
MR R-ear AC_Act	61.0	8.0	93.0	15.6	0.7169
MR L-ear AC_Act	64.0	5.0	94.0	25.0	
Air conduction (AC) – speech range (1500, 2000, 3000 Hz)					
SR R-ear AC_Act	38.3	2.0	81.7	24.9	0.2917
SR L-ear AC_Act	45.0	2.0	91.7	22.6	
Air conduction (AC) – emotions range (4000, 6000, 8000 Hz)					
ER R-ear AC_Act	56.7	2.0	95.0	26.4	1.000
ER L-ear AC_Act	55.8	4.0	96.7	29.9	
Bone conduction (BC) – motor range (250, 500, 750, 1000 Hz)					
MR R-ear BC_Act	65.8	1.0	98.3	37.6	0.7223
MR L-ear BC_Act	58.0	5.0	77.5	21.9	
Bone conduction (BC) – speech range (1500, 2000, 3000)					
SR R-ear BC_Act	43.3	1.0	81.7	22.8	0.1023
SR L-ear BC_Act	46.7	3.0	75.0	16.9	
Bone conduction (BC) – emotions range (4000, 6000, 8000 Hz)					
ER R-ear BC_Act	41.0	1.0	145.0	46.9	0.6829
ER L-ear BC_Act	38.3	2.0	68.3	17.7	

* Wilcoxon signed-rank test
MR – motor range; SR – speech range; ER – emotions range

TABLE 7. Differences between the normal and the actual sound of reception values

Parameters	Median	Minimum	Maximum	Standard deviation	p*
Air conduction (AC) – motor range (250, 500, 750, 1000 Hz)					
MR R-ear AC_Act	37.0	2.0	74.0	14.6	0.9921
MR L-ear AC_Act	41.0	2.0	75.0	18.3	
Air conduction (AC) – speech range (1500, 2000, 3000 Hz)					
SR R-ear AC_Act	31.67	2.0	75.0	23.6	0.3528
SR L-ear AC_Act	36.6	2.0	91.6	22.9	
Air conduction (AC) – emotions range (4000, 6000, 8000 Hz)					
ER R-ear AC_Act	45.0	5.0	83.3	22.9	0.2639
ER L-ear AC_Act	51.6	-3.3	93.3	25.5	
Bone conduction (BC) – motor range (250, 500, 750, 100 Hz)					
MR R-ear BC_Act	37.5	-5.0	53.3	15.9	0.5008
MR L-ear BC_Act	32.5	3.0	53.7	13.8	
Bone conduction (BC) – speech range (1500, 2000, 3000)					
SR R-ear BC_Act	33.3	3.0	71.6	19.8	0.1153
SR L-ear BC_Act	36.7	2.0	65.0	15.5	
Bone conduction (BC) – emotions range (4000, 6000, 8000 Hz)					
ER R-ear BC_Act	28.3	-11.6	53.3	20.5	0.5311
ER L-ear BC_Act	28.3	-1.6	55.0	16.0	

* Wilcoxon signed-rank test
MR – motor range; SR – speech range; ER – emotions range

TABLE 8. Statistically significant relationships between values

Parameters	R Spearman's	t(n-2)	p
Motor range (250, 500, 750, 1000 Hz)			
Psychosocial dimension & MR BC_Act	-0.396574	-2.36615	0.0256
Global QoL & MR BC_Act	-0.390273	-2.32173	0.0272
Speech range (1500, 2000, 3000 Hz)			
Global QoL & SR AC_Act	0.350042	2.08058	0.0458
Global QoL & SR AC_Act	0.374591	2.24942	0.0317
Emotions range (4000, 6000, 8000 Hz)			
Personal dimension & ER AC_Act	0.320452	1.88353	0.0690

MR – motor range; SR – speech range; ER – emotions range; BC – bone conduction; AC – air conduction; QoL – quality of life

DISCUSSION

In year 1994 the World Health Organization Quality of Life (WHO QOL) defined quality of life as "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, personal beliefs, social relationships and their relationship to salient features of their environment" [17]. The above definition tries to take into account different perspectives on the perception of ageing related to the main scientific fields: psychology, sociology and medicine. Quality of life is connected with many individual (subjective and objective) factors, interrelated and subject to different changes. This means that health experiences may be both a determinant and a result of ageing [17].

CONCLUSIONS

1. The results of the current study show a similar distribution of data in comparison with the results by Frąckowiak [8]. In both studies, the global quality of life is perceived at a moderate level by the majority of respondents regardless of their age. Slight differences can be seen in the distribution of low and high perceived quality of life. Frąckowiak's study revealed that participants were less likely to declare high levels of quality of life as they got older [8], which is also confirmed by the present study.
2. It should be emphasized that, in the younger group, the declarations of perceived quality of life at the moderate and low levels are similar (46.1 and 30.8, respectively), while in the older group they amounted to 66.7 and 26.7, which indicates that the latter had a relatively better sense of global quality of life. However, the study results confirm the hypothesis that the sense of quality of life among the elderly is generally at a satisfactory level. The greatest changes take place

in the psychosocial dimension in the early aging group and in the psychophysical dimension for the late aging group.

3. In the study, the following structure of quality of life has been demonstrated by comparing the different dimensions of quality of life. In the older group, the metaphysical dimension brings the highest results, followed by the personal, psychosocial, and psychophysical dimensions. In the younger group, the personal dimension is ranked 1st followed by the metaphysical, psychophysical, and psychosocial dimensions. This corresponds to the ideas of Frąckowiak: "Thanks to transcendental values connected with the spiritual dimension, older people are able to exceed their limitations and achieve a good quality of life" [8]. This is in accordance with the results of other studies [2, 3].
4. According to Pietruski, disturbances in acoustic energy conduction may be the cause of conductive hearing loss (ear wax) or sensorineural hearing loss associated with nerve cell damage (objective factor) [18]. This may give rise to psychological barriers in elderly people who start to hear poorly and, as a result, experience a poorer quality of life. However, the present study does not confirm this assumption.
5. The concepts of quality of life by the WHO and Frąckowiak [8] indicate 2 approaches to quality of life assessment: objective and subjective, of which the latter seems to play a more important role in the evaluation of the standard of living at this stage of life, as emphasized in the present study.

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