

Received: 18.07.2012
Accepted: 28.12.2012

A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection

DOI:
10.5604/17307503.1030212

THE IMPACT OF THERAPIST TRAINING IN INTERPERSONAL COMMUNICATION ON REHABILITATION OUTCOME FOR TRAUMATIC BRAIN INJURY PATIENTS

Wiesław Tomaszewski^(A,B,C,D,E,F)

College of Physiotherapy, Wrocław, Poland

SUMMARY

Background:

The aim of the study was to evaluate the effectiveness of rehabilitation of traumatic brain injury (TBI) patients when conducted by therapists who had participated in a training program on effective patient communication, as compared to rehabilitation administered by therapists without this training.

Material/ Methods:

The study included 40 TBI patients under treatment in a phased rehabilitation program. The experimental group (E) included 20 patients trained by therapists who participated in the training course on effective patient communication, while the control group (K) included 20 patients trained by rehabilitation therapists who did not participate in this program. The research methods included analysis of documentation, structured clinical interview, and the Rehabilitation Effectiveness Rating Scale.

Results:

The differences between the results obtained at baseline and follow-up from group E were highly significant for both mental and physical comfort and the assessment of the ability to communicate. The contingency coefficient indicates a significant relationship between the program and the improvement of mental and physical comfort ($C_{sk} = 0.644$), and the ability to communicate ($C_{sk} = 0.47$). These same differences were not significant in group K.

Conclusions:

There was a significant association between the therapists' participation in training for effective patient communication and the psycho-physical comfort of patients, as well as their ability to communicate in social situations. The rehabilitation of patients after traumatic brain injury is thus more effective when conducted by therapists trained in effective patient communication.

Key words: emotional disturbances, social discomfort, communication disorders

INTRODUCTION

Traumatic brain injury (TBI) occurs when the brain is injured by the action of external forces (WHO, 2004). The damage can be classified according to the severity of injury, the mechanism of formation (e.g. closed or open) or other factors (e.g. the location of the area of injury or damage). The expression “head trauma” is often used as though it meant the same as TBI, but the former term has a broader meaning, because it includes damage to other organs besides the brain, such as the scalp or skull (Moskała et al., 2000, 2007; Pačhalska, 2007).

TBI is one of the main causes of death and disability worldwide, especially among children and adolescents (WHO, 2004). Among the causes of injury are falls, traffic accidents, and the effects of violence (Pačhalska, 2007). The number of cases can be reduced by applying transportation safety measures (e.g. seat belts, helmets) and enforcing compliance with traffic laws and safety rules. There are also useful educational campaigns aimed at preventing injuries and preventing social dependence among people who have suffered such injuries (WHO, 2004).

A TBI can be caused by a direct blow to the head or by acceleration. The original injury is often accompanied by a variety of phenomena, causing additional brain damage during the first few minutes, or even days. This secondary damage is mostly cardiovascular, as well as the effects of increased intracranial pressure, which contributes to an increase in the extent of the initial damage (Moskała et al., 2007; Rehman et al., 2008).

The victims of brain injuries caused by motor vehicle accidents are very often young people, active in their personal life or career, who intend to study, start a family or begin professional work (DuCrocq et al., 2006). After they have regained consciousness, the long-term effects of brain damage begin to be visible. These can be divided into:

- physical problems (disturbances of movement or the sensory apparatus, such as sight, touch, or taste);
- cognitive impairment (involving memory and concentration);
- changes in emotional states and behavior, self-control, motivation, etc.

The profile of disorders depends not only on the size and location of the brain damage itself, but also on the setting in which rehabilitation is undertaken; in general, patients receive the best treatment outcomes in a multidisciplinary rehabilitation center (Thaler et al., 2003; Tepas et al., 2013), and the implementation of effective, early neurorehabilitation is also crucial (Pačhalska et al., 2010). After the period of so-called “spontaneous improvement,” further recovery may still occur, but often it is difficult to accurately predict how quickly and to what extent this occurs (DuCrocq et al., 2006; Agraval et al., 2012).

Many authors emphasize that the main obstacle to improvement in status are emotional and behavioral changes, which strongly overlap with each other, taking various forms (Mauritz et al., 2006, DuCrocq et al., 2006). One common change is the loss of emotional control, which is referred to as emotional lability (instability). The emotional state changes faster than normal; there can be, for exam-

ple, a sharp jump from sadness to happiness (or vice versa), or a sudden transition from laughter to tears or from calm to anger. These states are one of the main difficulties for the patients in effectively communicating with therapists and family members, which in turn is a major obstacle in the process of rehabilitation (Benedictus et al., 2012).

Poor communication, when combined with the patient's other problems, can lead to mood disorders in the patients, including anxiety and depression (Kaczmarek et al., 2003). Disturbances in interpersonal communication between therapist and patient generally inhibit the flow of information and cause the patient to lose confidence in the therapist (Gainotti, 2003; Kądziaława, 2003; Lefebvre et al., 2007).

The training program

The team of therapists working in the Department of Medical Rehabilitation at the Cracow Rehabilitation Center, where a multi-phase rehabilitation program is standard (Pačhalska et al., 2003; Grochmal-Bach et al., 2009; Tomaszewski et al., 2011) took part in a 40-hour training program entitled Effective Patient Communication (Pačhalska & Kaczmarek, 2013), conducted as part of the program called „the Academy of Life.” The training took place in two stages, and included:

- 20 hours of lectures on the multi-faceted consequences of brain injury, with particular emphasis on problems that occur in the field of communication in social situations. These lectures were conducted by university professors of neuropsychology, neurolinguistics, and the sciences of cognition and communication, who had not only knowledge, but also clinical experience in the treatment of brain injury and coma. At the end, the therapists took a proficiency test, which was intended to make them aware of their level of knowledge (and possibly further training in the case of a poor result).
- 20 hours of workshops covering a comprehensive analysis of the difficulties in communicating with TBI patients undergoing rehabilitation, including SWOT analysis (Strengths, Weaknesses, Opportunities, Threats). During the workshop, therapists learn to identify errors in communication by analyzing video recordings of the interviews of therapists with TBI patients. In order to better understand the problems in communication with the patient, errors were identified according to the scheme of forming a text for each category. Most attention was paid to non-verbal communication (facial expressions, gestures, pantomime). Emphasis was placed on mastering the ability to predict patient aggression. Therapists were trained to identify five groups of signals that predict patient aggression: (1) what the patient is saying; (2) changes in the patient's voice; (3) changes in the patient's facial expression; (4) changes in the patient's behavior; and (5) the patient's emotions.

The aim of the present study was to evaluate the effectiveness of the rehabilitation of TBI patients when conducted by therapists who participated in the Effective Patient Communication program (EPC), compared with patients rehabilitated by a team of therapists who did not participate in this program.

MATERIAL AND METHODS

Biographical and clinical characteristics of the patients

The study included 40 TBI patients treated in the Medical Rehabilitation Department at the Cracow Rehabilitation Center according to a multi-phased rehabilitation program (Pačhalska et al., 2003). The experimental group (Group E, n = 20, 13 men and 7 women) were treated by a team of therapists who participated in the EPC training program described above. The control group (Group C, n = 20, 11 men and 9 women) were treated by a team of therapists who had not yet attended this program.

This selection of groups was motivated by the following factors:

- the lack of a training program similar to the EPC during the time when the control group was in rehabilitation;
- the need to verify the newly developed EPC training program in a clinical setting by comparing the results obtained in the process of rehabilitation before and after this program was implemented.

The vast majority of these patients were young persons between the ages of 21 and 32 years. The average age in Group K was 25.7 years (SD = 6.81), while in group E the mean age was 31.8 years. The immediate cause of injury in all patients in both groups was a motor vehicle accident, and all suffered a brainstem contusion resulting in a prolonged coma. All patients had 3 points on the Glasgow Coma Scale at the time of admission to intensive care. The average duration of unconsciousness was 6 days; the shortest time was 5 hours, and the longest was two months.

The exclusion criteria for this experiment were as follows:

- aphasia or dysarthria, diagnosed in neuropsychological examination;
- severe memory and attention disorders;
- severe emotional and motivational problems;
- serious clinical condition preventing participation in the study (such as serious cardiovascular disease, respiratory problems, bedsores, chronic wounds or skin ulcers, etc.).

Research methods

In order to assess rehabilitation outcome the following research tools were used:

- Analysis of patient documentation (medical history, test results, including MRI and CT),
- Clinical interview, focused on the purpose of research. Particular emphasis was in it placed on how the patient was dealing with the limitations imposed by the TBI, the patient's attitude (with particular emphasis on the image of self and future), the hierarchy of values (with particular emphasis on the purpose of life), and the personality of the patient (with particular reference to the available information on the premorbid personality).

The Efficacy Assessment Scales for TBI Patients (Pačalska & MacQueen, 1998). Two subscales-were chosen to evaluate:

- Psycho-physical comfort, measured by pain management, coping with sleep disorders, and mood control, especially the overall assessment of the level of anxiety, sadness, or excessive gaiety.
- The assessment of communication, which was broken down into separate scores for comprehension of speech, speaking, reading, and writing.
- The evaluation was performed in three to five steps, based on the estimated percentage involvement of the patient in the completion of the particular task. The level of assistance required by the patient was determined by the following point-scale, adapted from the widely used ASIA Standards for the Neurological and Functional Classification of Spinal Cord Injuries (ASIA 1996, Baranowski 2000):
 - 1 or 2 points: total dependence (patient’s own share: 0-25%);
 - 3 to 5 points: limited autonomy (patient’s own contribution: 50%- 75%, or independent but under the supervision of a guardian);
 - 6 to 7 points: autonomy (patient’s own contribution: 100%, with or without adaptive devices)

The assessment was performed by a physician specializing in rehabilitation, based on his own research and clinical interview. Points were awarded by a qualified team of 3 judges, which consisted of a physician specializing in rehabilitation, a physical therapist, and a neuropsychologist. The experiment was approved by all the patients, and by the appropriate Ethics Committee.

RESULTS

Assessment of mental and physical comfort

The results of the cumulative assessment of the mental and physical comfort of the patients from both groups at baseline and follow-up are presented in Table 1.

An analysis of the results from the experimental group at baseline and follow-Table 1. Mental and physical comfort in the experimental and control groups

Group	Exam	Points							Total*	The significance of differences
		1	2	3	4	5	6	7		
Experimental	baseline	18	10	6	15	5	5	1	60	$\chi^2 = 45.953,$ $p = 0.0001$
	follow-up	0	1	6	11	10	20	12	60	
	Δ	-18	-9	0	-4	5	15	11		
Control	baseline	7	7	10	15	14	5	2	60	$\chi^2 = 3.093$ $p = 0.797$
	follow-up	6	9	7	20	13	2	3	60	
	Δ	-1	2	-3	5	-1	-3	1		

* For purposes of analysis, the number of questions in the assessment of mental and physical comfort (3 questions on each test) multiplied by the number of persons.

up shows that the largest difference between the results occurs in the lowest scores (1-2 points) and highest score (6-7 points). At baseline, the 1-2 point range accounts for 28 scores, which is nearly half the total, while at follow-up, this number is reduced to one score. There were 6 scores in the 6-7 point range at baseline, but at follow-up, this number increased to 32 scores (a 530% increase).

At the the middle level of the scale (4 and 5 points), the differences between the distribution of scores at baseline and followup were statistically highly significant ($\chi^2 = 45.953$, $p = 0.0001$), and so it is reasonable to conclude that rehabilitation conducted in this way significantly improved the mental and physical comfort of these patients. The contingency coefficient Csk came to 0644, which indicates a strong and significant relationship between the rehabilitation and the improved mental and physical comfort of patients.

In the control group, on the other hand, there were no significant differences between the baseline and follow-up results ($\chi^2 = 3.093$; $p = 0.797$). A more detailed analysis of the control group shows that, in contrast to group E, the number of lowest possible and highest possible scores (1 and 7 points respectively) underwent minimal change: in the former case (1 points), this number decreased by 1 score, and in the latter (7 points), it increased by 1. The largest change took place in the number of ratings in the mid-level scale (4 points), which at baseline increased by 5 scores, which is about 30%.

It is interesting to note the reduced number of 6-point scores, from 5 at baseline to 2 at follow-up, which may suggest a subjective feeling of worsened mental and physical comfort for some patients. These circumstances (beyond the size of the chi-square test) imply either no relationship between the course of rehabilitation and the comfort of patients, or growing criticism and a realistic assessment of the situation.

Assessment of the ability to communicate in social situations

The difference in the total number of points obtained in the evaluation of the ability to communicate in social situations in both research groups at baseline and follow-up are presented in Table 2.

A comparison of the total number of points obtained in the assessment of communication skills of the patients in Group E at baseline and follow-up reveals large differences that are statistically significant ($\chi^2 = 27.041$; $p = 0.001$). The total number of scores obtained in the lower and middle level (1 to 4 points) at follow-up is less than 30% of the baseline results.

This means that patients who at baseline were not able to perform a task or required considerable assistance, and had little success in the process of communication, at baseline required minimal assistance in the process of communication.

Similarly, the total number of scores obtained in the middle (upper) and upper level of the scale (5 to 7 points.) is respectively increased by 30, a 270% increase. This means that patients who were able to communicate in rehabilitation under the supervision of a mentor (e.g. used minimal assistance with shopping and paying tips or asking for a phone number from information, etc.) passed to a group of people who could independently communicate in the testing process.

Table 2. Difference in the total number of points obtained in the evaluation of the ability to communicate in social situations in the experimental and control groups at baseline and follow-up

Group	Exam	Points							Total*	significance
		1	2	3	4	5	6	7		
Experimental	baseline	22	12	14	14	5	8	5	80	$\chi^2 = 27.041$
	follow-up	6	9	8	9	18	14	16	80	$p = 0.001$
	Δ	-16	-3	-6	-5	13	6	11		
Control	baseline	13	6	9	9	25	16	2	80	$\chi^2 = 1.409$
	follow-up	10	5	11	11	23	16	4	80	$p = 0.965$
	Δ	-3	-1	2	2	-2	0	2		

* For purposes of analysis, the number of questions in the assessment of the quality of communication (4 test questions) multiplied by the number of persons.

This is particularly important from the perspective of qualitative analysis. It means that these patients at baseline required considerable assistance in communicating in test situations, while at follow-up they generally understood the instructions and were able to carry out the tests.

The contingency coefficient C_{sk} was calculated at 0.47, which indicates a strong and significant relationship between the rehabilitation and the quality of communication.

An analysis of the data obtained at baseline and follow-up in the control group shows that the number of scores in the lower end of the scale (1 and 2 points) decreased from 19 to 15, a difference of 4. However, the number of scores in the upper level (7 points) increased from 18 to 20. A comparison of the total number of points obtained in the assessment of communication skills in the control group showed no statistically significant differences ($\chi^2 = 1.409$; $p = 0.965$). The coefficient C_{sk} was calculated at 0.11, which shows almost no significant relationship between the course of rehabilitation and the degree of improvement in communication.

DISCUSSION

The training of therapists in effective communication with patients is a relatively new problem (WHO, 2004). Hardly any center in the world has undertaken such training, hence the problem of scant scientific documentation (Tepas et al., 2013). Moreover, as already mentioned, there have been to date only a few studies on the effectiveness of rehabilitation carried out by therapists trained in effective communication (Paçalska et al., 2001). Therefore, our results are difficult to compare with other studies.

Therapists have reported that one of the main reasons for the problems in communication between therapist and patient are emotional disorders, including aggression. Some explanation of this problem has been given by Gainotti (2003). The author notes that the emotional disturbances that occur in patients with TBI

and can cause difficulty in communicating with family and therapists are caused by two types of factors. These include:

1. neurological factors: in patients with a typical TBI resulting from a motor vehicle accident in which there was „acceleration - deceleration” the axial structure of the brain and the regions lying at the base and medial part of the frontal and temporal lobes are often damaged. Particularly vulnerable to damage are thus cortical and subcortical structures that play a critical role in various aspects of emotion. The main clinical proof of this statement is the well-known prevalence of emotional disorders and neurobehavioral disorders compared to motor, sensory or aphasic symptoms in TBI patients as compared to patients after a stroke. These disorders can be divided into three categories, namely:
 - a syndrome of profound apathy, characterized by a lack of emotional response to pleasant or unpleasant events and the lack of goal-directed behavior;
 - instability, or inability to exert socially acceptable control over emotional reactions (e.g. explosions of aggression in frustrating situations);
 - non-specific anxiety or depressive reactions, characterized by a strong sense of danger and sadness for no apparent reason, which may be accompanied by vegetative symptoms.
2. mental or psychodynamic factors, which result from the evaluation process performed by the patient in terms of:
 - the importance of the consequences of brain trauma in the patient’s personal and professional life;
 - the actual and perceived ability of the patient to cope with the consequences in a variety of social situations.

A critical factor in this kind of evaluation process for the patient is to be aware of the damage and its consequences (Pačhalska 2007, Tepas 2013). When the patient is fully aware of the painful truth about his changed situation, the emotional reaction can take the form of a catastrophic reaction, which is a difficult to control anxiety bordering on panic and despair. The patient may also develop a more stable anxiety-depression syndrome (Gainotti, 2003).

When the level of awareness of their true situation is low, for example in patients with frontal lobe damage or, in general, the right hemisphere of the brain, one can observe a pathological lack of interest or even apathy (Prigatano 2003). The patient’s behavior is then classified as „lack of motivation,” which is a fundamental problem that causes barriers in communication with the patient. In these cases, there is often a failure to continue rehabilitation (Pačhalska et al., 2001; Lefebvre et al., 2007; Tomaszewski et al., 2011).

It should be added that the problems in communication between the therapist and the patient, which often relate to young people and even the very young, are associated with severe memory loss and, therefore, problems in communicating in social situations. That is why they hinder not only effective rehabilitation, but also a possible return to public life, to work, which can make the patient a permanent burden for the family. Therefore, it is necessary to deal with the emotional outbursts,

the childish behavior, the lack of initiative, with a low tolerance for frustration and impulsive or aggressive reactions (Prigatano, 2003; Lefebvre et al., 2007).

Although there are several medical methods for behavioral and psychological treatment, targeted to these disorders, it must be admitted that in many cases the prognosis is not positive, and a return to a normal, productive life often turns out to be impossible. Often, the only real purpose of rehabilitation is to achieve relative independence and improve communication in social situations (Gainotti, 2003; Lefebvre et al., 2007; Paçhalska, 2003, 2008).

Understanding the problems of these patients, and gaining theoretical knowledge and practical experience in the disruption of communication between therapist and patient contributed to the good outcomes obtained by patients rehabilitated by therapists who participated in the Effective Patient Communication training program.

These results are of great importance for the fate of these patients. The issue raised in this article turned out to be extremely important in the process of comprehensive rehabilitation of TBI patients, and as such should be further explored in future research on the rehabilitation of patients with severe trauma.

CONCLUSIONS

1. In the experimental group, there was a strong association and significant improvement of the relationship between the course of rehabilitation and the mental and-physical comfort of patients and the ability to communicate in social situations, while no such relationship could be seen in the control group.
2. The team of therapists who have been trained in Effective Patient Communication showed higher efficiency in the rehabilitation of TBI patients compared with patients rehabilitated by a team of therapists who did not take part in the training.

REFERENCES

- Agrawal, A., Galwankar, S., Kapil, V., Coronado, V., Basavaraju, S.V., McGuire, L.C., Joshi, R., Quazi, S.Z. & Dwivedi. S. (2012). Epidemiology and clinical characteristics of traumatic brain injuries in a rural setting in Maharashtra, India. 2007-2009. *International Journal of Critical Illness and Injury Sciences*, 2(3), 167-71.
- Baranowski, P. (2000). Kompleksowe postępowanie lecznicze w urazach kręgosłupa i rdzenia w odcinku szyjnym. *Ortopedia Traumatologia Rehabilitacja*, 2(2), 17-22.
- Benedictus, M.R., Spikman, J.M. & van der Naalt, J. (2010). Cognitive and behavioral impairment in traumatic brain injury related to outcome and return to work. *Archives of Physical Medicine & Rehabilitation*, 91(9), 1436-41.
- Ducrocq, S.C., Meyer, P.G., Orliaguet, G.A., Blanot, S., Laurent-Vannier, A., Renier, D. & Carli, P.A. (2006). Epidemiology and early predictive factors of mortality and outcome in children with traumatic severe brain injury: experience of a French pediatric trauma center. *Pediatric Critical Care Medicine*, 7(5), 461-7.
- Gainotti, G. (2003). Assessment and treatment of emotional disorders. In: P.W. Halligan, U. Kischka & J.C. Marshall (eds.), *Handbook of clinical neuropsychology*. (pp. 368-386). Oxford: Oxford University Press.
- Kaczmarek, B.L.J., Code, C. & Wallesch, C.-W. (2003). Brain damage from the inside: Luria's study of Lieutenant Zassetsky. In: C. Code, Y. Joannette & A.R. Lecours (eds.), *Classic cases in neuropsychology*, vol. 2 (pp. 131-144). Hove & New York: Psychology Press.

- Kądziaława, D. (2003). Zaburzenia językowe po urazach czaszkowo-mózgowych. In: A. Herzyk, B. Daniluk, M. Pąchalska & B.D. MacQueen (eds.), *Neuropsychologiczne konsekwencje urazów głowy: Jakość życia pacjentów* (pp. 17-24). Lublin: Wydawnictwo UMCS.
- Kolb, B. & Whishaw, I.Q. (2003). *Fundamentals of Human Neuropsychology*. New York: V. Worth Publishers.
- Lefebvre, H., Pelchat, D. & Levert, M.J. (2007). Interdisciplinary family intervention program: a partnership among health professionals, traumatic brain injury patients, and caregiving relatives. *Journal of Trauma Nursing*, 14(2), 100-113.
- Mauritz, W., Wilbacher, I., Majdan, M., Leitgeb, J., Janciak, I., Brazinova, A. & Rusnak, M. (2008). Epidemiology, treatment and outcome of patients after severe traumatic brain injury in European regions with different economic status. *European Journal of Public Health*, 18(6), 575-80.
- Moskała, M., Gościński, I., Kałuża, J., Polak, J., Krupa, M., Adamek, D., Pityński, K. & Miodoński, A. (2007). Morphological aspects of traumatic chronic subdural hematoma capsule: SEM studies. *Microscopy and Microanalysis*, 13, 211-219.
- Moskała, M., Gościński, I., Krupa, M. et al. (2000). Pourazowe krwiaki śródczaszkowe. *Neurotraumatologia*, 1, 28-31.
- Pąchalska, M. (2003). Neuropsychological rehabilitation for post-traumatic frontal syndrome in patients recovering from prolonged coma: A preliminary report. *Acta Neuropsychologica*, 1(2), 194-227.
- Pąchalska, M. (2007). *Neuropsychologia kliniczna: Urazy mózgu*. Warsaw: Wydawnictwo Naukowe PWN.
- Pąchalska, M. (2008). *Rehabilitacja neuropsychologiczna: Procesy poznawcze i emocjonalne*. Lublin: Wydawnictwo UMCS.
- Pąchalska, M. & Kaczmarek, B.L.J. (2013). *Neuropsychologia kliniczna. Ujęcie procesowe*. Warsaw: Wydawnictwo Naukowe PWN.
- Pąchalska, M. & MacQueen, B.D. (1998). *Skale Oceny Efektywności Rehabilitacji Pacjentów po Urazach Czaszkowo-Mózgowych*. Kraków: Fundacja na Rzecz Osób z Dysfunkcjami Mózgu.
- Pąchalska, M., Moskała, M., MacQueen, B.D., Polak, J. & Wilk-Frańczuk, M. (2010). Early neurorehabilitation in a patient with severe traumatic brain injury to the frontal lobes. *Medical Science Monitor*, 16(12), CS157-67.
- Pąchalska, M., Talar, J., MacQueen, B.D. & Baranowski, P. (2001). Ocena efektywności komunikacji lekarz-pacjent po urazie czaszkowo-mózgowym. *Ortopedia Traumatologia Rehabilitacja*, 3(5), 109-120.
- Prigatano, G.P. (2003). Assessment and rehabilitation of anosognosia and syndromes of impaired awareness. In: P. W. Halligan, U. Kischka, J. C. Marshall (eds.), *Handbook of clinical neuropsychology* (pp. 387-397). Oxford: Oxford University Press.
- Rehman, T., Ali, R., Tawil, I. & Yonas, H. (2008). Rapid progression of traumatic bifrontal contusions to transtentorial herniation: A case report. *Cases Journal*, 1(1), 203.
- Talar, J., ed. (2003). *Neurorehabilitacja u progu XXI wieku*. Bydgoszcz: Katedra i Klinika Rehabilitacji AM w Bydgoszczy.
- Tepas, J.J. 3rd, Pracht, E.E., Orban, B.L. & Flint, L.M. (2013). High-volume trauma centers have better outcomes treating traumatic brain injury. *Journal of Trauma and Acute Care Surgery*, 74(1), 143-8
- World Health Organization (2004). Annex Table 2: Deaths by cause, sex and mortality stratum in WHO regions, estimates for 2002. IN: *The World Health Report 2004 – Changing History*. Accessed on-line 2008-11-01.

Address for correspondence:

Wiesław Tomaszewski
College of Physiotherapy
T. Kościuszki 4, 50-038 Wrocław, Poland
e-mail: w.tomaszewski@wp.pl