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BEHAVIORAL ADAPTATION TO CHRONIC ILLNESS – IS NEUROCOGNITIVE DETERIORATION ALWAYS A THREAT?

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SUMMARY

Background Compliance is a measure of good adaptation to illness by persons in self-managed health care. Although it is directly connected with treatment effectiveness, compliance can be disturbed by a cognitive decline resulting from the illness itself. The present study was designed to explore the nature of neurocognitive (NC) impairment as a potential threat to behavioral adaptation (BA) to chronic disease.

Material/ Methods: A battery of neuropsychological tests was used along with self-reported measures of health behaviors and medical compliance. Four groups of participants (N=126) were examined, including three clinical groups with chronic illnesses affecting NC resources to various extents.

Results: Although differences were found in NC functioning between the groups, there was no group effect in BA. Moreover, somewhat surprisingly, analysis revealed a negative correlation between NC and BA scores, indicating that participants affected by NC decline were more prone to engage in self-management of their illnesses.

Conclusions: The study confirmed NC deficits in vulnerable clinical groups, but the level of BA did not differ between the groups. Nevertheless, participants with lower NC scores seem to reveal better behavioral adaptation.

Key words: medical compliance, cognitive decline, brain damage, health behavior

INTRODUCTION

Many chronic illnesses can cause brain damage, which leads to various functional and neurocognitive impairments, more or less severe. Some studies have demonstrated that the level of neurocognitive function, or its change, is not directly linked with life satisfaction, well-being, feelings of happiness or quality of life (e.g. Hanks et al. 1999, Kozora et al. 2008, Łojek & Bornstein 2004). However, the majority of researchers have found that brain damage and related neurocognitive disorders are significantly associated with depression, anxiety and decreased quality of life (Hofmeijer 2005, Hochstenbach et al. 2001, Prigatano 1999, Pachalska 2008). This evident, but still unclear role of neuropsychological variables in the everyday life of the chronically ill should be studied as a potential vital factor in quality of life, medical services use, adherence to treatment, and economy of medical treatment. Of perhaps equal importance, the ability to maintain appropriate self-care activities - understood as behavioral adaptation to illness - in patients with brain damage has not yet been systematically investigated (Arlt et al. 2008, Insel et al. 2006).

The aim of the present study was to explore the relationship between neurocognitive (NC) functioning and behavioral adaptation (BA) to chronic illness. **Behavioral adaptation** was defined here in terms of everyday health behaviors and medical compliance. For the elderly population, this issue is especially important to explore, because both cognitive decline and complex medication are characteristic for this age group.

MATERIAL AND METHODS

Participants: A group of 126 participants agreed to take part in the study. There were three clinical groups:

- right brain damaged subjects (RBD, n=37) with evident, medically diagnosed brain damage, mostly the consequence of a stroke,
- patients with chronic obstructive pulmonary disease (COPD, n=32), with probable, but not diagnosed neurocognitive deficits, resulting mainly from hypoxia (Grant et al. 1980, Grant et al. 1982, 1987).
- patients with neurological problems without brain damage (mostly with discopathy, NBD, n=20), presumed not to have neurocognitive decline, although they had other problems with their somatic condition.

Apart from these three clinical samples, one group of participants without disabling chronic conditions was also examined (healthy controls, HC, n=37). In the clinical groups, all consecutively admitted patients were tested during their stay in hospital or rehabilitation clinic. The minimum time post onset was 3 months. The patients did not suffer from other life-threatening diseases, although some medical conditions were often present (ex. diabetes, hypertension), as is characteristic for an elderly population. This concerns also the control group. No observable signs of dementia were present among the participants, and they were all in good interpersonal contact.

Some differences between groups were found in gender (49 women, 77 men, $Chi^2(1,126)=6.22$, $p=0.013$), education ($x=11.82$ years, $SD=3.7$, $F(3,122)=2.60$, $p=0.056$) and age ($x=64.94$, $SD=11.3$, $F(3,122)=2.11$, $p=0.103$). All these variables were controlled in further analysis.

Neuropsychological assessment: Tests were selected to enable adequate assessment of those cognitive functions which seem important for everyday functioning in illness: comprehension, memory, attention, verbal expression, and executive functions. These brain functions were presumed to have potential influence on perception and realization of medical compliance and self-management (Insel et al. 2006). A multidimensional diagnosis of NC functioning was made using the following measures:

– The Trail Making Test (parts A and B, Polish version: Kądzielawa et al. 1990),
– The Vocabulary Test (subscale from the WAIS-R, Polish version: Brzeziński et al. 1996),
– The Rey-Osterrieth Complex Figure Test (Polish adaptation: Strupczewska 1990),
– The Ruff Figural Fluency Test (Polish adaptation: Łojek & Stańczak 2005),
– The Rey 15-items Memory Test (Polish version: Choynowski & Kostro 1980),
– Bourdon's Letter Cancellation Test (Polish version: Dudek & Kietliński 1968),
– The Boston Diagnostic Aphasia Examination – comprehension of speech and reading (Goodglass & Kaplan 1983, unpublished Polish experimental adaptation by Ulatowska & Kądzielawa).

Correlations between these tests made it possible to calculate the level of general NC functioning, which was assessed by computing the scaled scores into one factor.

The measurement of **behavioral adaptation (BA)** was conducted in two dimensions. Declared activity directed toward maintaining or repairing health was analyzed using the Health Behaviors Inventory (HBI, Juczyński 2001). The Inventory has four scales: preventive behaviors, feeding habits, positive psychological attitude, and health practices. At the same time, the sum of the results from all four scales gives a score for general health behaviors. The second dimension of BA was assessment of medical compliance, as measured by the General Adherence Measure (GAM, DiMatteo et al. 1993). This scale was constructed to estimate the level of the patient's subjective difficulties in medical compliance. After measuring the correlation between HBI and GAM scores ($r(123)=0,35$, $p=0,005$), the general level of BA was computed into one factor.

Questionnaires concerning BA were given to all groups, as various health problems, although milder, were also common in HC. An additional instruction was given in this group, not to answer the questions which were considered inappropriate to the participant's own health status. This was the case only for two items marked as such by one participant.

Additional measures: As is generally known, many chronic illnesses are accompanied by emotional problems, especially **depression** (see for example Kauhanen et al. 1999, Penninx et al. 1999). To control its possible influence on BA, emotional state was measured using half of the items (from A to N) from Beck's Depression Inventory (BDI). The rest of the items were excluded because of their confounding somatic aspect. Following the assumption that subjective evaluation of health habits and medical compliance could also be biased by **social desirability,** the Marlowe & Crowne's Social Desirability Scale (Polish adaptation: Korzeniowski 1980) was used.

RESULTS

Neurocognitive functioning: The results of the assessment of NC functioning, BA, depression and social desirability for all groups are provided in Table 1. Anova with covariance (for gender, age and education) indicated a main group effect for NC functioning, with the parallel effects of age – $F(1,93)=28.74$, $p=0.000$ – and education – $F(1,93)=28.05$, $p=0.000$. For NC functioning there were no effects of emotional or social control variables, and after they were factored out, the main effect of group still remained significant: $F(3,90)=4.33$, $p=0.007$.

Comparison between particular groups showed that the RBD and COPD groups had lower levels of general NC functioning than participants from the HC group. As assumed, the highest difference was between the group of patients with medically diagnosed brain damage, i.e. RBD, and the HC group: $t(63)=-3.180$, $p=0.002$. A difference between these two groups was also observed in age - $t(71)=-1.92$, $p=0.059$ - and gender – $t(71)=2.21$, $p=0.030$. In the case of gender, for all participants there were no significant differences in NC functioning between men and women: $t(103)=1.57$, $p=0.12$. Although age negatively correlated with the NC factor ($r(104)=-0.39$, $p<0.01$), its direction was opposite to the difference found between the RBD and HC groups. Thus it would seem reasonable to state that the differences emerging in the level of NC functions between these groups were not related to demographic variables.

As predicted, the patients with COPD also had worse NC functioning than the HC group: $t(53)=2.20$, $p=0.032$. There was no difference in gender, age or education: all t-tests $t(67)<1.7$, n. s. At the same time, patients with NBD scored at a level comparable to the HC group in the NC tests: $t(47)= 0.43$, $p=0.70$. All clinical samples achieved a level of NC functioning comensurate with the results of previous research (Borak et al. 1996, Grant et al. 1980, Grant et al. 1982, 1987, Hadjistavropoulos & Craig 1994, Prigatano 1999, Rzadkiewicz 2008, Tun et al. 1997).

Interestingly, even though no relation was found between NC and depression scores for all participants - $r(92)=-0.06$, $p=0.58$, with control for group, age and education – the same groups which revealed NC decline also had a

Table 1. Main variables compared between groups

Group / Variable	RBD	COPD	NBD	HC	Anova
General neurocognitive functioning*	x=-0.43, SD=1.17	x=-0.16, SD=0.93	x=0.43, SD=0.90	x=0.33, SD=0.70	F(3,91)=4.90, p=0.003
General behavioral adaptation*	x=0.06, SD=1.14	x=-0.05, SD=0.91	x=0.19, SD=0.96	x=-0.13, SD=0.96	F(3,91)=0.99, p=0.400
Emotional state	x=11.12, SD=7.83	x=12.64, SD=9.07	x=7.15, SD=6.18	x=6.97, SD=5.26	F(3,108)=4.52, p=0.005
Social Desirability	x=17.09, SD=3.40	x=17.96, SD=4.25	x=17.30, SD=4.32	x=18.09, SD=5.00	F(3,108)=0.19, p=0.903

Anova was calculated with control for age, gender and education. RBD – patients with right brain damage, COPD – patients with chronic obstructive pulmonary disease, NBD – patients with neurological diseases but no brain damage, HC – healthy controls

* For these factors all means are based on scaled, standardized data, z-scores, with mean=0 and SD=1.

markedly increased level of emotional problems (see table 1) in comparison to the HC group.

Behavioral adaptation. Calculation of ANOVA with covariance for general behavioral adaptation revealed no main group effect, though an effect of age was observed: $F(1.93)=6.21$, $p=0.015$. Behavioral adaptation correlated negatively with emotional state – $r(91)=-0.42$, $p=0.000$) – and positively with social desirability – $r(91)=0.40$, $p=0.000$ – confirming the assumption that both variables may be related to subjective measures of BA. Analysis of ANOVA for BA, with additional control for the above-mentioned variables, confirms effects of depression – $F(1,92)=13.71$, $p=0.000$ – and social desirability – $F(1,92)=6.96$, $p=0.000$ – but also reveals a main effect of group: $F(3,90)=2.74$, $p=0.049$. The levels of NC functions and BA for particular groups is illustrated in figure 1.

More detailed analysis of the BA factor in relation to NC resources was done to better understand its complexity. First, a partial correlation (with control for age, education and group) of NC functions with behavioral adaptation was calculated. It revealed, somewhat unexpectedly, a negative relation – $r(91)=-0.22$, $p=0.039$, which was slightly weaker after controlling additionally for BDI and social desirability: $r(85)=-0.20$, $p=0.061$. This means that participants with lower scores in NC tests had a higher level of health behaviors and adherence. When all these variables were put into linear regression analysis, three of them predicted 25.4% of variance in BA level (corrected $r^2=0.254$, $F(3,89)=11.45$, $p=0.000$): social desirability ($\beta=0.32$, $p=0.001$), emotional state ($\beta=-0.32$, $p=0.002$) and group ($\beta=-0.21$, $p=0.024$). For NC functioning which did not enter the model, $\beta=-0.168$, $p=0.074$. Despite the fact that this is only a tendency, the result confirms the direction of the observed relationship.

The same regression analysis was conducted separately for adherence and health behaviors. Of all the relevant variables (age, education, group, NC functioning, depression and social desirability), general adherence was weakly predicted only by depression (corrected $r^2=0.08$, $F(7,86)=2.18$, $p=0.04$, $\beta=-0.25$, $p=0.025$), indicating that participants with a higher level of depres-

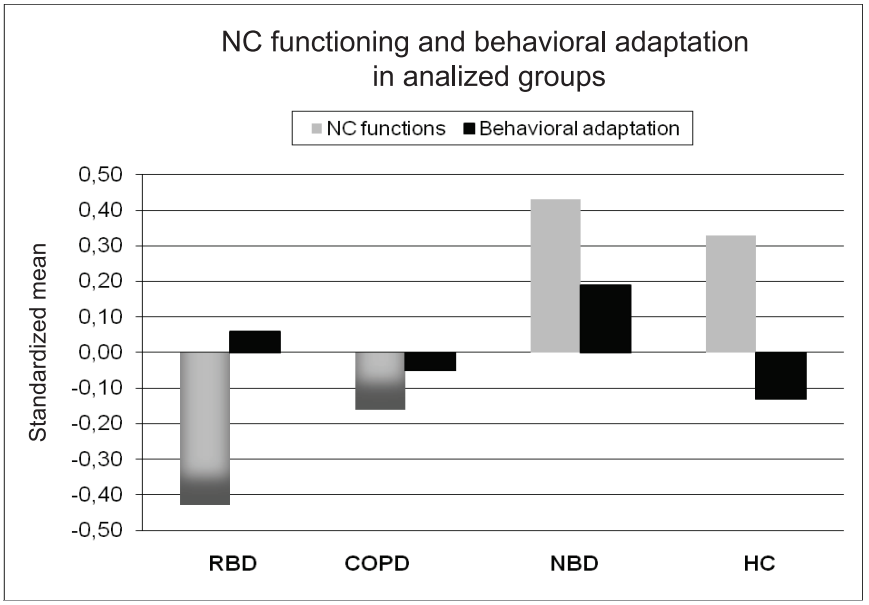

Fig. 1. Level of neurocognitive (NC) functioning and behavioral adaptation (BA) – grey shadowed surfaces differ from non-shadowed grey ones

RBD – patients with right brain damage, COPD – patients with chronic obstructive pulmonary disease, NBD – patients with neurological diseases but with no brain damage, HC – group of healthy control participants. All values are based on scaled, standardized data, z-scores for measures used to asses NC and BA, with mean=0 and SD=1

sion seemed to declare worse medical compliance. This is in accordance with a previous study by DiMatteo et al. (2000). The results obtained for the Health Behaviors Inventory were visibly different. 32.5% of the variance of this dependent measure was explained by five variables (corrected r^2=0.325, F(7,86)=7.39, p=0.000): NC functioning (β=-0.36, p=0.002), depression level (β=-0.30, p=0.002), social desirability (β=0.28, p=0.004), education (β=0.28, p=0.005) and group (β=-0.23, p=0.018). In other words, participants who had a lower level of NC functioning and/or were in a group with more probable occurrence of NC deficits scored better in HBI, as did those who had lower scores in depression.

CONCLUSIONS

The results confirmed previous findings that different NC functioning levels between the groups of participants may be a factor of the somatic condition, according to the specific nature of the illness (Borak et al. 1996, Hochstenbach et al. 2001, Tun et al. 1997). Although the level of NC functions was lower in 2 of the 3 clinical groups, there were no evident differences in general behavioral adaptation, when compared to controls. Control of emotional state and social desirability made it possible to observe and confirm its relation with behavioral adaptation (DiMatteo et al. 2000), suggesting that emo-

tional problems may be an obstacle in self-managed illness, whereas the need for social approval may mask real problems with behavioral adaptation. However, even when these confounding variables are factored out, there is an interesting relation that appeared between NC functioning level and BA, especially health behaviors. It turned out that those participants who received lower scores in NC tests, or were in a group with more probable NC deficits, were more careful about their health. Thus the efficiency of NC functioning in brain damaged persons may not directly reflect their behavioral adaptability. The main result of this study points out that the presence of mild NC impairments, caused by brain damage, does not necessarily imply a worsening of health behaviors and medical compliance in chronically ill patients. On the other hand, if patients show well preserved NC skills, this does not necessarily mean that their health self-management skills are better (DiMatteo et al. 2002).

It should be noted, however, that the data reported here are not in accordance with some previous research concerning adherence in older age (Arlt et al. 2008, Insel 2006) and that it is still difficult to clearly interpret the diversity in results of separate regression analyses for health behaviors and adherence. One possible explanation, which also accounts for the discrepancy between the present study and other studies, may lay in methodology and formulation of the questionnaire items. The Health Behaviors Inventory lists specific types of activity that a person may engage in every day, whereas in the General Adherence Measure the questions are more general and concern mostly difficulties in compliance. Both measures are self-descriptive, subjective, and as such may not reflect the actual performance in self-management among the participants in this research. Perhaps there were also other factors, not taken into account, that are responsible for the obtained results for BA (ex. two clinical groups were assessed in a rehabilitation clinic, whereas the third one was in a hospital ward). Additionally, more objective measures of both health behaviors and adherence would be of use here, such as electronic measurement of prescribed dose taking or a record of the time when a given physical activity was practiced. Further studies aiming at development of better psychometric tools for BA assessment are needed, along with researches designed to carefully study the nature of this important but complex issue.

This study had an explorative nature, so it permits only limited generalizations. Nevertheless, the results obtained point out some important potential among the chronically ill, even patients with some neuropsychological deficits caused by their disease, which may help in maintaining appropriate self-management, allowing them to make an adequate behavioral adaptation.

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