

Association of Neuroticism with Sick Building Syndrome, Quality of Life and Psychomotor Performance

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ABSTRACT

In a group of 221 healthy employees of both sexes the relationship between neuroticism, and perceived quality of life (WHOQOL), inadequate work organization (IWO), Sick Building Syndrome (SBS) and speed and accuracy of simple reaction time was studied. The level of neuroticism was assessed by Cornell Index (C.I.), and psychomotor speed and accuracy by electronic psychodiagnostic instrument Complex Reactionmeter Drenovac (CRD). All subjects underwent the same testing procedure completing C.I., SBS, IWO and WHOQOL–BREF questionnaires. The obtained results revealed that persons with more pronounced emotional stability perceive their life better in quality, their work environment with less SBS symptoms, and report more adequate work organization. Furthermore, they have better simple reaction time scores to visual stimuli.

Key words: neuroticism, sick building syndrome, quality of life, psychomotor performance, inadequate work organization

Introduction

Personality is usually defined as a circuit of relatively stable behavioural and psychological characteristics unique to a person. Also, it is generally agreed that a personality variable must exert a relatively consistent influence on behaviour patterns across qualitatively different situations and over time. Thus, the complexity of personality traits may explain the way people tend to think about themselves and other people, the way they interpret and deal with events in the environment, and the way they react emotionally to all situations. Recent studies in the field of personality qualities lean dominantly on a five-factor model proposed by Costa and McCrae in 1992¹, which presents a hierarchical organization of traits in terms of five basic dimensions: Neuroticism, Extraversion, Openness to experience, Conscientiousness and Agreeableness. Numerous studies have shown applicability of this model across observers and different cultures denoting these five dimensions a good basis for personality descriptions^{2–5} and the construction of new inventories⁶.

Neuroticism is usually defined as a mental or personality disturbance not attributable to any known neuro-

logical or organic dysfunction. These characteristics make it constant source of negative affective disposition. Recent study by Kendler and co-workers⁷ on a large sample of over 20000 same-sex twin pairs found that levels of neuroticism strongly predict the risks for major depression. Although our study deals with healthy working population the main assumption was that the different degree of »neuroticism – emotional stability« would yield diverse reactions on health and environment problems in the same working environment.

World Health Organization in the early 1980s defined a range of physical symptoms reported by workers within a building as »Sick Building Syndrome« (SBS), indicating that no specific etiologic factor can be attached to these symptoms, and that »SBS results in substantial disruption of people's work performance and personal relationships and considerable loss of productivity«⁸. The factors related to the way work is organized (index of inadequate work organization – IWO) contribute in influencing health and well being⁹. This launched a number of reports on association between SBS and personality

traits^{10–12}, many of which pointing to the significant connection between workers psychological characteristics and SBS symptoms^{13,14}. The main debate on different shares of psychosocial and environmental factors goes on with results depending largely on specific characteristics of samples (subjects, buildings and work characteristics) incorporated into the studies. Nevertheless the substantial impact of psychosocial factors (personality traits, job satisfaction, quality of life etc.) remains in the focus of investigations¹⁵. Our previous study performed on healthy video display terminal operators showed that complaints concerning health status were significantly related to the dimension of neuroticism¹⁶. Judge and co-workers¹⁷ performed a meta – analysis on five-factor model of personality and job satisfaction and revealed neuroticism as the strongest predictor of job dissatisfaction.

Assuming that the concept of quality of life goes beyond symptoms and beyond the effects of diseases on functional status, the WHO quality of life questionnaires (WHOQOL-100, and a shorter version WHOQOL-BREF) were developed^{18,19}. The WHOQOL questionnaires measure quality of life as perception of ones own position in life in relation to goals, expectations, standards and concerns, in four different domains (physical health, psychological health, social relationships and environment). Studies examining relationship between personality dimensions and perceived quality of life in different domains are rare.

Because it is important to determine whether emotional state, motivation and characterological predisposition influence attitudes and perception of objective environment, we focused on neuroticism (among five main personality traits) as possibly the most prominent in highly subjective assessment of health and environment problems in working population. For this purpose we chose Cornell Index (C.I.) as a multiscale measure of personality traits with 12 subordinate dimensions, whose sum score denotes position on continuum neuroticism – emotional stability²⁰. Besides very probable impact of stable personality trait (as neuroticism is) on perception factors, we were interested in potential interdependence (connection) of the same psychological characteristic with psychophysiological characteristics – speed and accuracy of simple reaction time to visual stimuli. Socan and Bucik²¹ found negative correlation between neuroticism and speed of response on reaction time tasks. Similarly, Cox-Fuenzalida and co-workers²² found higher levels of neuroticism associated with decreased reaction time on auditory vigilance task.

The aim of this study was to examine the relation between the psychological dimension of emotional stability – neuroticism and subjective assessment of quality of life, as well as specific health symptoms related to work in office buildings (Sick Building Syndrome) and complaints on work organization. Further task was to find possible correlation between the dimension of neuroticism – emotional stability and performance (speed and accuracy) on simple reaction time tasks.

Subjects

This study was planned as a cross-sectional (prevalence) study that comprised 221 healthy subjects of both sexes (172 female, and 49 male) aged between 19–68 years ($X = 43.5 \pm 9.6$), all employed as office workers with similar level of education (12–16 years of schooling). Subjects were recruited from an insurance company, the national library and the national archive. Microclimate conditions and total dust exposure in air conditioned buildings have been checked periodically, and according to official reports were within the permitted limits (air temperature range, 22°C–25°C; air humidity range, 40%–60%, total dust concentrations $< 10 \text{ mg/m}^3$)²³.

The study was designed in accordance with Helsinki declaration and approved by the authorized Ethical committee. All subjects were recruited on voluntary basis after announcement given by their employers, and were asked to sign a consent form following full information about the study protocol. Next, they all underwent the same testing procedure at the Institute for Medical Research and Occupational Health.

Methods

Cornell Index – Form N3 (C.I.) is a self-administered true/false, multiscale measure of personality traits and psychosomatic disturbances (questionnaire). It consists of 100 questions, grouped in 12 scales: Hypersensitivity, Phobia, Anxiety, Depressiveness, Cardiovascular conversions, Inhibitory conversions, Gastro conversions, Hypochondria, Obsessive-compulsive tendencies, Impulsive tendencies, Aggression and Psychopathic tendencies. Additional 5 questions cover a »lie scale« (*L*) with items of high desirability and low endorsement, where elevated scores suggest that the individual is presenting himself or herself in an overly positive light, attempting to create an unrealistically favourable view of his or her adjustment; and 5 questions cover »frequency scale« (*F*) with items of high desirability and high endorsement. The C.I. was assembled as a series of questions referring to symptom complexes, which would not only serve as a standardized psychiatric history and guide to interview, but which could differentiate with statistical reliability persons with serious personality and psychosomatic disturbances from the rest of the population^{20,24}. It has proven itself as a useful tool in detecting personality traits in different groups of subjects^{25–31}. Kulenovic and Busko³² performed empirical evaluation of diagnostic and pragmatic utility of the Cornell Index on a sample of 348 prison inmates in Croatia. Scores 0–27 indicate normal level of symptoms, while only scores above 50 signify severe level of symptoms.

Complex Reactionmeter Drenovac (CRD) – is an electronic psychodiagnostic test series, designed as a standardized instrument for assessment of reaction time and speed of information processing³³. It has been recognized as a good objective measure for psychological performance^{34–39}.

CRD 31 test measures simple visual discrimination of signal location. The test is applied on a signal-control board of the instrument, which contains 9 signal lamps and 9 keys placed under each signal lamp. The task is to detect the location of the actual light signal and to press the answer key below the lamp with right (or left) hand as quickly as possible. The CRD 31 test consists of 60 items and the result is expressed in seconds needed to complete the whole test. Only correct reaction leads to the next task, without any delay. Approximately 60% of the variance is explained by the factor of visuospatial location discrimination^{33,40}. The CRD test system is dependent neither on language, nor on educational or cultural background differences. The whole test procedure with instructions lasts for only five to seven minutes. Four variables were used for statistical analysis: CRD 31 R – Total test solving time for right hand in seconds; CRD 31 R Err – Total number of errors on all 60 tasks with right hand; CRD 31 L – Total test solving time for left hand in seconds; and CRD 31 L Err – Total number of errors on all 60 tasks with left hand.

CRD 21 test measures speed and accuracy of visuospatial orientation, a mental function that includes complex analytical processes³³. The test is applied on a signal board consisting of 18 signal lamps along the edges of the board and 20 keys for answering, placed in the middle and arranged into five columns and four rows. The task is to determine the intersection of the row and column indicated by the signal lamps and to press the key located there. The test consists of 35 items. Correct reaction leads to the next task, without delay. Two variables were used for statistical analysis: CRD 21 – Total test solving time in seconds and CRD 21 Err – Total number of errors.

WHOQOL-BREF – A short form of the WHO Quality of Life questionnaire (WHOQOL-BREF) was used to estimate subjective quality of life in the previous 2-week period. Estimates were scored for the quality of life in four domains: physical health (WHOQOL-D1), psychological health (WHOQOL-D2), social relations (WHOQOL-D3) and environment (WHOQOL-D4), with scores for each domain expressed within the range 4–20¹⁸.

SBS (Sick Building Syndrome) – Work-related health symptoms and complaints that are commonly attributed to indoor air quality problems were assessed by trained medical specialist using standardised questionnaire⁴¹. The participants were asked whether they have experienced any of 10 symptoms (fatigue, eye irritation, throat irritation, trouble in concentrating, headache, cough, nose irritation, sneezing, cold, skin irritation) on three or more days during previous two weeks in their workplaces. Index of sick building syndrome (SBS) is the number of work-related health complaints/symptoms in previous two weeks per worker (range 0–10).

IWO (Inadequate Work Organization) – IWO index is the number of complaints on inadequate work organisation and work task characteristics (pressure to be productive and/or high work speed, inadequate work control/autonomy, numerous work demands, insufficient

contact with colleagues) per worker⁹ in the range between 1.0 (no complaints) and 2.0 (complaints on all inadequate work characteristics).

Results and Discussion

Table 1 shows descriptive statistics for the whole sample (N=221). All mean scores and standard deviations for Cornell Index and its subscales, as well as CRD test results are within expected range for healthy adult population.

The whole sample comprised 172 female and 49 male subjects. Differences between these two subgroups did not reach statistically significant level for most of the tested variables, except for IWO ($X_{\text{males}}=1.15 \pm 0.18$; $X_{\text{females}}=1.21 \pm 0.24$; $p=0.028$), CRD 31 L Err ($X_{\text{males}}=0.39 \pm 0.86$; $X_{\text{females}}=0.15 \pm 0.63$; $p=0.004$) and

TABLE 1
DESCRIPTIVE STATISTICS (N=221)

| Variable | Mean | Std.Dev. | Range |
|----------------------------------|--------|----------|------------|
| Age (years) | 43.498 | 9.667 | 19–68 |
| Cornell Index | 15.910 | 10.525 | 1–54 |
| Hypersensitivity | 2.018 | 1.612 | 0–7 |
| Phobia | 1.186 | 1.292 | 0–6 |
| Anxiety | 3.787 | 2.267 | 0–10 |
| Depressiveness | 0.498 | 1.267 | 0–7 |
| Cardiovascular conversions | 0.900 | 1.228 | 0–5 |
| Inhibitory conversions | 0.765 | 0.948 | 0–5 |
| Gastro conversions | 0.991 | 1.621 | 0–9 |
| Hypochondria | 2.367 | 2.241 | 0–9 |
| Obsessive-compulsive conversions | 0.778 | 1.104 | 0–7 |
| Impulsive conversions | 0.643 | 0.969 | 0–3 |
| Aggression | 0.946 | 1.167 | 0–6 |
| Psychopathic tendencies | 1.036 | 0.938 | 0–5 |
| L – scale | 0.697 | 0.828 | 0–3 |
| F – scale | 4.511 | 0.717 | 2–5 |
| CRD 31Right (sec) | 36.70 | 8.05 | 26.00–54.5 |
| CRD 31Right, Error | 0.11 | 0.38 | 0–3 |
| CRD 31Left (sec) | 34.46 | 3.63 | 24.50–48.2 |
| CRD 31Left, Error | 0.20 | 0.69 | 0–5 |
| CRD 21 (sec) | 78.31 | 9.34 | 39.40–408 |
| CRD 21Error | 4.30 | 8.57 | 0–90 |
| WHOQOL-D1 (physical health) | 15.73 | 2.32 | 9.14–20 |
| WHOQOL-D2 (psycholog. health) | 15.29 | 2.30 | 6.40–19.33 |
| WHOQOL-D3 (social relations) | 15.43 | 2.71 | 6.67–20 |
| WHOQOL-D4 (environment) | 14.13 | 2.24 | 5.71–20 |
| IWO (complaints on work org.) | 1.194 | 0.231 | 1–2 |
| SBS (number of symptoms) | 3.40 | 2.17 | 0–10 |

CRD – Complex Reactionmeter Drenovac
WHOQOL – WHO Quality of Life questionnaire
IWO – Inadequate work organization
SBS – Sick building syndrome

CRD 21 Err ($X_{\text{males}}=2.98 \pm 6.40$; $X_{\text{females}}=4.68 \pm 9.07$; $p=0.006$). Women more often complained on inadequate work organisation (IWO) than men. Due to very small real number of errors on CRD 31 tests (visual discrimination tasks for left and right arm) and CRD 21 (visuospatial orientation) these »error« variables (CRD 31RErr, CRD 31LErr and CRD 21Err) were omitted from further analysis, although visuospatial orientation error rate showed expected male dominance. Female and male subjects were similar in age ($X_{\text{females}}=43.26 \pm 9.2$; $X_{\text{males}}=44.32 \pm 11.2$; $p=0.08$).

Interestingly enough even though women obtained higher mean than men on Cornell Index, the difference was not statistically significant ($X_{\text{females}}=16.8 \pm 10.2$; $X_{\text{males}}=12.9 \pm 11.3$; $p=0.34$). The same woman dominance was found for eight C.I. subscales, except for scales: Obsessive-compulsive tendencies, Impulsive tendencies, Aggression and Psychopathic tendencies. These four scales expectedly demonstrated somewhat higher mean scores for males, although not statistically significant. The reason why these differences are not statistically significant may lay in the fact that the overall range of C.I. scores of our sample is actually small, and does not exceed the boundaries for normal population.

Significant correlations between 12 specific Cornell Index subscales and variable C.I. (sum result on the whole test) are expected and are in the range between 0.48 for the Impulsiveness scale and 0.78 for Hypochondria scale. F (frequency) and L (lie) scales do not correlate with C.I. (L scale does not correlate with any observed variable). F scale shows small negative correlation with Cardiovascular conversions, Hypochondria and Obsessive-Compulsive tendencies. Expectedly, all correlations between C.I. subscales are significant except association between Paranoid tendencies and Gastro conversions scale. The highest were found between Hypersensitivity and Hypochondria (0.53); Hypochondria and Phobia (0.52);

Depressiveness and Obsessive-compulsive tendencies (0.51); Hypersensitivity and Phobia (0.50) and between Anxiety and Phobia (0.50). No significant correlation was found between error rate on simple visual discrimination tasks (for right and left hand) and neuroticism. This is in accordance with work of Socan and Bucik²¹. We found weak correlation between neuroticism (C.I.) and speed (CRD 31R; CRD 31L, CRD 21) – not exceeding 0.28., and expectedly higher correlations between speed and age (from 0.27 to 0.50). Very similar results were found by Persson and Ørbæk¹⁵.

After controlling for the effect of age on variables neuroticism and psychomotor speed, we still found significant partial correlations between C.I. and CRD 31R ($r_{\text{part}}=0.17$; $p=0.003$); as well as between C.I. and CRD 21 ($r_{\text{part}}=0.22$; $p<0.001$). Thus, lower emotional stability (i.e. higher neuroticism) was related to longer reaction time on visuospatial and simple reaction time tasks. Further, neuroticism was related to reporting of more SBS symptoms ($r=0.34$) and lower satisfaction with ones quality of life (coefficients between -0.42 and -0.58) (Table 2). Weak correlation was found between age and C.I. (0.18); Hypersensitivity (0.20); Phobia (0.18); Cardiovascular conversions (0.22); and Hypochondria (0.18) among personality traits variables. Despite statistical significance of these correlation coefficients, practical significance remains vague.

Relatively substantial correlations were found between total C.I. scores and all four WHOQOL-BREF domains, ranging from -0.42 to -0.58 . They indicated negative relations between neuroticism and perceived quality of life. Similar relations were found in the study by Kovac and Kuruc⁴², and the studies by Musthoff and co-workers^{43,44}, irrespective of different questionnaires used to measure neuroticism (EPI and NEO-PI-R) or different population studied (psychiatric outpatients).

TABLE 2
CORRELATION MATRIX (N=221)

| | C.I. | CRD 31 R | CRD 31 L | CRD 21 | SBS | IWO | D-1 | D-2 | D-3 | D-4 |
|---------|-------|----------|----------|--------|-------|-------|-------|-------|-------|-------|
| CRD 31R | 0.27 | | | | | | | | | |
| CRD 31L | 0.18 | 0.81 | | | | | | | | |
| CRD 21 | 0.28 | 0.42 | 0.27 | | | | | | | |
| SBS | 0.34 | 0.17 | 0.11 | 0.15 | | | | | | |
| IWO | 0.17 | -0.04 | -0.09 | -0.03 | 0.17 | | | | | |
| D-1 | -0.49 | -0.26 | -0.25 | -0.07 | -0.36 | -0.29 | | | | |
| D-2 | -0.58 | -0.16 | -0.12 | -0.08 | -0.16 | -0.10 | 0.53 | | | |
| D-3 | -0.42 | -0.11 | -0.09 | 0.02 | -0.03 | -0.04 | 0.30 | 0.49 | | |
| D-4 | -0.46 | -0.17 | -0.18 | -0.12 | -0.23 | -0.13 | 0.55 | 0.53 | 0.34 | |
| Age | 0.18 | 0.50 | 0.37 | 0.27 | 0.19 | 0.05 | -0.18 | -0.13 | -0.11 | -0.06 |

C.I. – Cornell Index; CRD – Complex Reactionmeter Drenovac (R – right hand, L – Left hand); SBS – Sick building syndrome; IWO – Inadequate work organization; D-1 – Physical health; D-2 – Psychological health; D-3 – Social relations; D-4 – Environment

Pairwise deletion of missing data

$r \geq 0.18$ are significant at $p < 0.01$

$r \geq 0.14$ are significant at $p < 0.05$

According to Cornell Index median value the whole sample was divided into two subgroups: the first (N=104) – those who's total score on C.I. was higher than median i.e. 15 or more (lower level of emotional stability), and the second (N=117) – with total C.I. score equal or lower than median (14), that denotes higher level of emotional stability (Table 3). Mean age for these groups was 44.5 and 42.6 respectfully, with no statistically significant difference. Educational level did not show significant difference between these subgroups either. The obtained results show significantly slower reaction time on visuo-spatial tasks (variables CRD), perceived lower quality of physical and psychological health (WHOQOL D1 and D2), perceived inferior social relations and environment (WHOQOL D3 and D4), and more complaints on work organisation (IWO) and work related health symptoms (SBS) in the first, less emotionally stable group. Furthermore, it is interesting that standard deviations are higher in individuals higher in neuroticism on reaction time tasks (CRD 31 and CRD 21). This is in accordance with recent findings by Socan and Bucik²¹ and Robinson and Tamir⁴⁵ who found that neurotic college students had more variable reaction times than their more stable peers. Also, Robinson and coworkers⁴⁶ investigated the relationship between reaction time variability and the level of neuroticism. Their results showed that greater variability tended to be associated with less distress among individuals low in neuroticism, but more distress among those high in neuroticism. These findings support the possibility that neuroticism operates as a distractor of performance.

Although our sample comprises healthy working population, even slightly elevated scores on neuroticism scale elicited significant differences in perceived quality of life and health measures, as well as slower reaction time on speed tasks. We can speculate on possible strong and long term influence of the stable dimension of emo-

tional stability – neuroticism on all aspects of human life, even when this dimension does not exceed »normal« boundaries. Present observations support recommendations to take into account the influence of neuroticism – emotional stability dimension on diverse symptom reports scores.

Conclusions

1. On a sample of 221 healthy subjects from working population of both sexes we found significant correlation between psychological dimension of neuroticism – emotional stability and the perception of quality of life. Those who showed higher emotional stability perceived their own lives as better in quality. Similarly they claimed less health symptoms related to SBS, and reported more adequate work organization. This finding supports the assumption that psychosocial as well as biological and chemical factors influence a vast range of symptoms experienced by office workers through yet not clear complex mechanisms.

2. Relation between dimension of neuroticism – emotional stability and simple reaction time to visual stimuli revealed expected significant trend; more stable individuals performing faster. Error rate did not discriminate our two subgroups. Expectedly age is related to reaction time to simple light stimuli.

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The authors declare no competing interests.

TABLE 3
SIGNIFICANT DIFFERENCES BETWEEN TWO SUBJECT SUBGROUPS ACCORDING TO THEIR TOTAL SCORE ON CORNELL INDEX

| Variable | Higher level of neuroticism, N=104 | | Lower level of neuroticism, N=117 | | t | p |
|--------------|------------------------------------|------|-----------------------------------|------|-------|-------|
| | X | SD | X | SD | | |
| CRD 31 Right | 37.5 | 4.3 | 36.0 | 3.6 | 2.74 | 0.006 |
| CRD 31 Left | 35.1 | 4.3 | 33.9 | 2.9 | 2.42 | 0.016 |
| CRD 21 | 89.1 | 64.9 | 68.7 | 26.1 | 3.12 | 0.002 |
| WHOQOL – D1 | 14.6 | 2.3 | 16.7 | 1.9 | -7.39 | 0.000 |
| WHOQOL – D2 | 14.2 | 2.5 | 16.2 | 1.7 | -7.25 | 0.000 |
| WHOQOL – D3 | 14.6 | 2.9 | 16.2 | 2.3 | -4.59 | 0.000 |
| WHOQOL – D4 | 13.4 | 2.4 | 14.8 | 1.9 | -5.14 | 0.000 |
| IWO | 1.24 | 0.2 | 1.15 | 0.2 | 3.02 | 0.003 |
| SBS | 4.2 | 1.9 | 2.7 | 2.1 | 5.61 | 0.000 |
| Age (years) | 44.5 | 9.5 | 42.6 | 9.8 | 1.47 | 0.142 |

CRD – Complex Reactionmeter Drenovac

WHOQOL – WHO Quality of Life questionnaire

IWO – Inadequate work organization

SBS – Sick building syndrome

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POVEZANOST NEUROTICIZMA SA SINDROMOM BOLESNE ZGRADE, KVALITETOM ŽIVOTA I PSIHOMOTORNIM REAGIRANJEM

SAŽETAK

U skupini od 221 zdravog zaposlenika oba spola ispitana je povezanost između neuroticizma, kvalitete života (WHOQOL), nezadovoljavajuće organizacije rada (IWO), Sindroma bolesne zgrade (SBS) te brzine i točnosti jednostavne psihomotorne reakcije. Stupanj neuroticizma procijenjen je Cornell Indexom (C.I.), a psihomotorna brzina i točnost elektronskim psihodijagnostičkim instrumentom Kompleksni Reakciometar Drenovac (CRD). U svih ispitanika primijenjeni su C.I., SBS, IWO i WHOQOL–BREF upitnici. Dobiveni rezultati pokazuju da emocionalno stabilnije osobe procjenjuju kvalitetu svoga života boljom, organizaciju rada adekvatnijom i manje se tuže na simptome koji upućuju na sindrom bolesne zgrade. Uz to, postižu bolje rezultate na zadacima jednostavne psihomotorne reakcije na vizualni podražaj.