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Assessment of Stress Level of Forestry Experts with Academic Education

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A B S T R A C T

This paper provides the results of an applied research of forests engineers connected to their risk of mental stress occurrence in everyday work. This paper also has a component of a basic research, in which the adequacy and reliability of applied methodology in this kind of researches is examined. The mental stress induced risk is tested by usage of an e-mail survey which consists out of 23-part ERI (Effort-Reward Imbalance) questionnaire. For the assessment of mental stress exposure level following indicators have been used: 1) ERI – ratio of devoted effort and achieved reward, and 2) overcommitment. These indicators have been analyzed in comparison to the demographic parameters (gender, age) and the complexity of assigned jobs of the interviewees. The interview was applied on a randomly sampled forestry experts employed in public and private sector. The analysis of reliability of the three components of ERI questionnaire has showed satisfactory internal consistency. Descriptive statistics has been done regarding gender and the complexity of assigned jobs. The testing of the »devoted effort/achieved reward« variable (E/R index) has shown a statistically significant difference of the index value between male interviewees on managerial and standard expert positions. The value of E/R index was x≥1 at 18.97% of the sampled interviewees, which indicates a divergence between devoted effort and achieved reward, and also points to a possibility of mental stress occurrence risk. Multiple response tables have shown that female interviewees with less than 20 years of professional experience manifest stress related symptoms earlier than their male colleagues with similar professional experience do. Regression analysis has shown a significant correlation of E/R index to gender, internship and overcommitment. This research also assesses the viability of the applied method as an instrument of forestry experts' mental stress level determination.

***Key words**: Effort-reward imbalance, risk of mental stress, forestry experts*

Introduction

In modern working environment mental stress has become an unavoidable question for employees and employers, but also for health, social and insurance related institutions. One of the most important tasks of employers is keeping of mental load and strain of employees on acceptable levels, all with long-term goal of diminishing the probability of mental stress occurrence and development.

According to latest researches[1], 28% of employees in Europe state that they are exposed to at least one of the indicators of mental stress. In the respective research, the key elements related to mental stress occurrence are control over business assignments, job advancement, education, interpersonal relations and wages. There is a consensus that permanent stress exposure can influence the mental health of employees with different kinds of consequences, such as the growing job absenteeism caused by mental stress related illnesses. The cost of »stress related illnesses« in EU surpasses 25 billion euros, and the struggle against stress has became a priority in Belgium, Denmark, France and Great Britain, where an entire specter of measures is undertaken, including financial supports, education and strengthening labor inspections.

Business obligations and responsibilities of personnel with an academic degree in modern environment often result with heighten mental strains and loads, for which the consequence is mental stress. The occurrence of stress produces at employees the following effects: lack of motivation, depression, »burn out« syndrome, and other negative consequences[2]. All of the above reflects upon

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their working outputs and creative potentials, but also on the performance of the company in which they are employed. The last decade has shown many claims from different professions for acknowledgment of stress as an occupational illness.

Mental stress manifests itself after occurrences onto which an individual cannot adapt himself. Schieman et al.[3] have studied negative effects of professional on private life, and have concluded several surprising twists related to occupation and mental stress. Personnel with academic education, managerial staff and employees with highest salaries are most highly exposed to negative impacts of their occupation onto personal life. That connection is defined as higher status stress. In Japan there is a term named »karoshi« which, translated literally, means death by too much work, and points out to obvious connection of excessive work and accompanying stress with mortality caused by labor overload[4].

There are over 1200 forest engineers employed at appropriate working positions within forestry sector of the Republic of Croatia, out of which majority is employed within »Hrvatske šume« Ltd., a state forest management company.

Stress related studies have so far formed two theoretical approaches to forecasting the increment of probability of illness occurrences: demand-control-support model[5,6] and effort-reward imbalance (ERI)model[7,8]. The latter has been applied in this research for the determining of mental stress levels of forest engineers in Croatia.

This research approach is chosen because of its feasibility and quick feedback of the research results. Another reason is financial, as the study of mental stress with the usage of other instruments its measurement (e.g. sweating of the palms, a blinking of the eye, changes in blood pressure or in the rhythm of breathing), is extremely complex and expensive, and cannot be implemented in a short period of time.

In recent stress related studies mostly used method are the ones based on ERI model. ERI indicator through subjective perspective of the interviewee points out to a quantified ratio of effort and its accompanying reward. Higher values of ERI indicators are interpreted as a higher mental strain of the interviewee, and thus a higher exposure to mental stress in professional environment.

$$\text{ERI} = \frac{\text{Devoted effort}^*}{\text{Achieved reward}^*}$$

* valuated by points through subjective perception

Available data connected to ERI model application analyze the negative effects of subjective perceptions of stress in professional environment onto the health of the employees. Ertel et al.[9] have studied psycho-social working conditions and subjective health perception of journalists with part-time jobs. Li et al.[10] have studied ERI index and job dissatisfaction of Chinese health professionals. Janzen et al.[11] have studied ERI, overcommitment and psychological stress of Canadian police officers. Respective studies point out to ERI model as an reliable instrument which provides viable results related to measurement of psycho-social stress.

Foundations of ERI model

Effort-Reward Imbalance Model (ERI) has been introduced by Seigrist et al. in 1986, and is considered to be one of the most important models in researches connected to occupational health[7,12,13]. The basic elements of the model are:

1. External objective effort, which is determined by professional tasks and commitments which are placed in front of the employee

2. External objective reward which is offered or promised as an element of social exchange, in form of money, respect, job safety or job advancement

3. Internal subjective overcommitment[13,14]. High job commitment influences the perception of both factors; high effort and low reward, and thus indirectly influence on the health of the employees[13]. It is considered that high commitment to job has direct influence of the health of the employee; all day work on longer periods can be very exhausting.

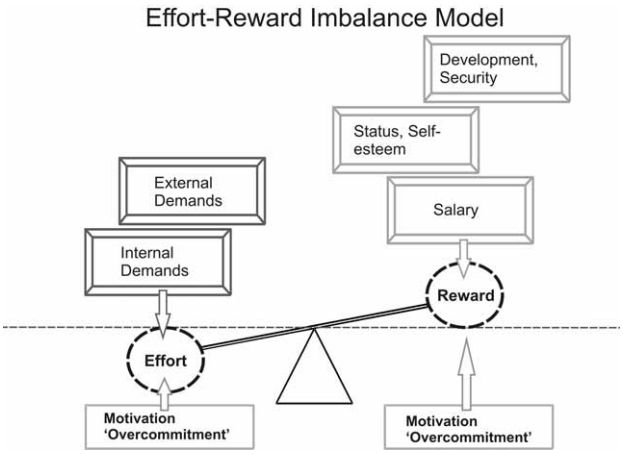

Fig. 1. Depiction of the key elements of the ERI model[7].

Research Goals and Methods

Research goal

Two goals have been set in front of this research; the first one was to estimate the mental stress levels of forestry experts with an academic degree through usage of »devoted effort/achieved reward« index and overcommitment of the ERI model. The second one was to examine the internal consistency of the used ERI questionnaire.

Research method

The sample was formed by random selection of organizational units to which's employees the questionnaire

TABLE 1
STRUCTURE OF DISTRIBUTED AND RETURNED QUESTIONNAIRES ACCORDING TO THE PLACE OF WORK OF THE INTERVIEWEES

Area of work	Questionnaires		
	Sent	Returned	Properly fulfilled
Forest extension service	10	4	4
Faculty of Forestry	6	6	6
»Hrvatske šume« Ltd	68	65	48
Total	84	75	58

via e-mail was send. The precondition for the fulfillment of the questionnaire was that the interviewees got their academic degree at the Faculty of Forestry in Zagreb, and that they are today employed in public or state part of the forestry sector.

Structure of the questionnaire and the valuation methodology

In the paper, the terminology expression for scale »effort« and »reward« is modified in the »devoted effort and achieved reward« by the authors with the aim, of clarification but also, of easer understanding for forestry sector readers of what the scale examines and what does the received answer quantify.

First part of the questionnaire addressed to general information of the interviewees, and the second one to their mental strain and stress (in the appendix).

For the valuation of devoted effort and achieved reward ERI questionnaire was used, which in his original version consisted out of 23 questions and three previously mentioned components: objective effort, objective reward and subjective overcommitment. For this research all three components were used, but within a set of 22 questions, which was adapted to the specificities of the object of the research; component »objective effort« contains in its original version six questions, while in this research it contains five, for the question related to physical strain was left out because interviewees were positioned to jobs which required low percentage of physical labor.

Within the »devoted effort« and »achieved reward« sets the interviewee was first placed to answer weather does he »agree or disagree with the following statement«. If he agreed, than he was asked to rang the intensity of his subjective estimation of stress, which was divided as follows:

1. I am not at all distressed
2. I am somewhat distressed
3. I am distressed
4. I am very distressed

Questions related to the objective effort are marked with points ranging 1 to 5, where »1« represents negation of the claim in the respective question, and »5« represents highest value of a positive answer (highly distressed). Questions related to »overcommitment« were ranked 1 to 4 (1 – I strongly disagree, 2 – I disagree, 3 – I agree, 4 – I strongly agree). Original version of ERI questionnaire was taken from web pages[15,16].

In the set of questions connected to »objective reward« ranking was done so that 5 points were assigned to »I receive maximum reward« answers, while not receiving earned reward was assigned to 1 to 4 points, where no reward receiving and »I am very stressed« answer was assigned with lowest value – 1 point.

Statistical analysis of the questionnaire

Data/answers gathered from the questionnaires were transformed into appropriate Excel data base, and valuated according to the previously explained procedure. Through usage of an algorithm ($ER=\Sigma E/\Sigma R\ c$) E/R index has been calculated, where the enumerator is the sum of points connected to devoted effort, and the denominator is the sum of points connected to achieved reward. The sum of points connected to reward was multiplied with corrective factor (0.4545), which was gained through following equation $c = 5/11$. The corrective factor (c) brings the sum of points connected to achieved reward to the sum of points connected to devoted effort at which their balance point (expressed through E/R index) is set to 1.00. Further data analysis has been performed in Statistica 7.1. software.

Analysis of the internal consistency of all parts of E/R questionnaire has been done through usage of Cronbach's α coefficient, where alpha (α)>0.7 represents a satisfying reliability of gained answers on questions set within one component of the questionnaire[17].

Descriptive statistics has been done on all components of the ERI model according to gender and job complexity, where jobs were separated as follows: 1 – Managerial working positions; 2 – Specialist working positions; 3 – General working positions

- Managerial working positions include position of manager of local forestry office and leading functions within regional forest office and Directorate of »Hrvatske šume« Ltd, leading functions within Forest Extension Service and scientific employees of the Faculty of Forestry in Zagreb with a degree of docent or higher.
- Specialist working positions include functions with special assignments (expert advisors) within »Hrvatske šume« Ltd. and Forest Extension Service, and scientific employees of the Faculty of Forestry in Zagreb with title »higher assistant«.
- General working positions include foresters assigned to specific forest management unit, general forestry employees of »Hrvatske šume« Ltd. and Forest Extension Service, and assistants at the Faculty of Forestry in Zagreb.

Spearman's correlation coefficient has been calculated for age of employees, total length of internship, sum of points connected to »overcommitment« and calculated values of E/R index.

Calculated values of E/R index are regarded as a measure of mental stress level (stress intensity), and was split into five categories:

1) 0.20–0.59
2) 0.60–0.99
3) 1.00–1.39
4) 1.40–1.79
5) 1.80–2.19

Calculated values of E/R index are considered to be an indicator of the level of work load or of the intensity of mental stress to which the interviewee is subjected to, while the lowest level of E/R index (the demarcation line) at which stress occurs is 1.0.

In the process of calculating Multiple response tables the following was taken into consideration: 1) categories of values of E/R index, 2) gender and 3) duration of internship (1–10 years, 11–20, 21–30 and 31–40). In the second analysis the variable »internship« was replaced by the »complexity of work« variable. The differences between the means of E/R index according to age classes, job complexity and »overcommitment« have been tested.

A regression analysis have been done, in which the dependent variable was the value of E/R index, and the independent variables where age, duration of internship and the sum of »overcommitment« points. Questions related to responsibility, complexity of job and its certainty (marked with E3, E6 and R13) have been put into a correlation with the value of E/R index, in order to test their possible connection to the intensity of mental stress.

Results

Through usage of reliability analysis and on the basis of calculated Cronbach's α a high inner consistency within all the three components of ERI model have been revealed (with α for »effort« at 0.79, for »reward« 0.78 and for »job commitment« 0.71).

Mean value of E/R index is similar to the one gained in Chinese testing of its health professionals ($\overline{X}$=0.64)[10]. At 18.97% of the interviewees the value of E/R index was higher than 1, which indicates a relative disproportion of devoted effort and achieved reward, and thus risk of mental stress development.

Increment of sum of points connected to »effort« is almost linear in its relation to the increment of the value of E/R index, while with the denoted trend the sum of points connected to »reward« is decreasing, as it can be seen in Figure 2.

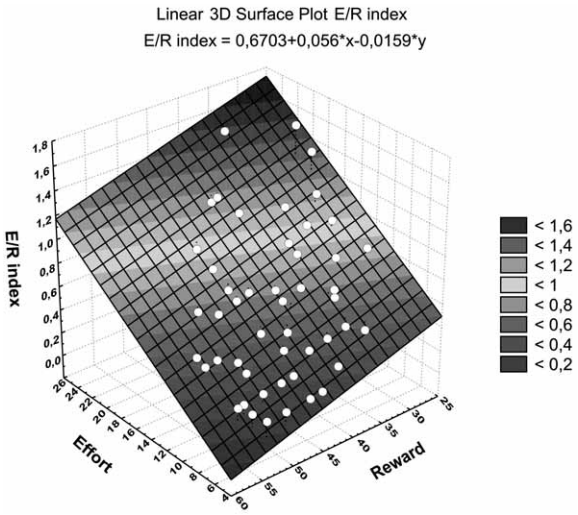

Fig. 2. E/R index dissemination in the case of stress assessment of forestry experts.

Descriptive statistics has been done according to gender and job complexity (Table 3), and it has shown that the largest differences between the means are the ones between managerial and expert positions taking gender into consideration. The largest misbalance between devoted effort and achieved reward was found at female interviewees on managerial positions. However, due to the small size of the sample, that result is without merit.

At male interviewees t-test has shown an existence of significant difference between the general and managerial working positions in the case of E/R index (t=–2.423; df=8; p=0.042). Other cross tabulations according to gender and job complexity did not show significant differences in its means. At the testing of »overcommitment« variable according to gender and job complexity no statistically significant differences in means were found.

Spearman's coefficient of ranking correlations has shown weak positive correlation of E/R index to the age of the interviewees (r_s=0.26; p<0.05), weak positive cor-

TABLE 2
MEAN ($\overline{X}$) AND STANDARD DEVIATION (SD) FOR ALL OF THE INTERVIEWEES

Indicator	$\overline{X}$	SD	Median	Min	Max
Age	39.33	9.35	41	25	59
Internship	13.49	9.19	14	0.7	33
Devoted effort	11.55	4.70	11	5	24
Achieved reward	42.22	7.93	41.5	28	55
E/R-index	0.64	0.34	0.60	0.21	1.57
Overcommitment	14.41	2.29	14	9	21

TABLE 3
DESCRIPTIVE STATISTICS ACCORDING TO GENDER AND JOB COMPLEXITY

Scale	Men (n=43)						Women (n=15)					
	General working positions (N=13)		Specialist working positions (N=21)		Managerial working positions (N=9)		General working positions (N=6)		Specialist working positions (N=8)		Managerial working positions (N=1)	
	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
Age	36.46	10.91	38.81	8.90	47.44	4.07	34.50	8.83	40.00	9.23	38.00	–
Internship	10.56	9.61	12.99	8.69	21.78	4.29	7.45	8.76	14.56	9.98	15.00	–
Effort	10.38	3.04	10.43	3.97	15.22	6.16	10.00	3.85	11.88	4.16	24.00	–
Reward	45.85	7.41	42.67	8.26	37.89	8.34	43.50	7.87	40.00	5.98	35.00	–
E/R-index	0.51	0.17	0.57	0.28	0.95	0.46	0.52	0.23	0.69	0.31	1.51	–
Overcommitment	14.23	1.54	14.29	2.47	15.11	2.67	14.17	3.31	14.25	2.05	16.00	–

relation of E/R index with internship (r_s=0,34; p_s<0.05) and strong positive correlation of E/R index with »overcommitment« (r=0.44; p<0.05).

Multiple response tables (Figure 3) have shown that much larger percentage (13.34%) of female interviewees with 11–20 years of internship show signs of mental stress than their male colleagues (2.33%) do. Male interviewees 21–30 years of internship show that they are more prone to mental stress (11.67%) than there female colleagues are (6.67%).

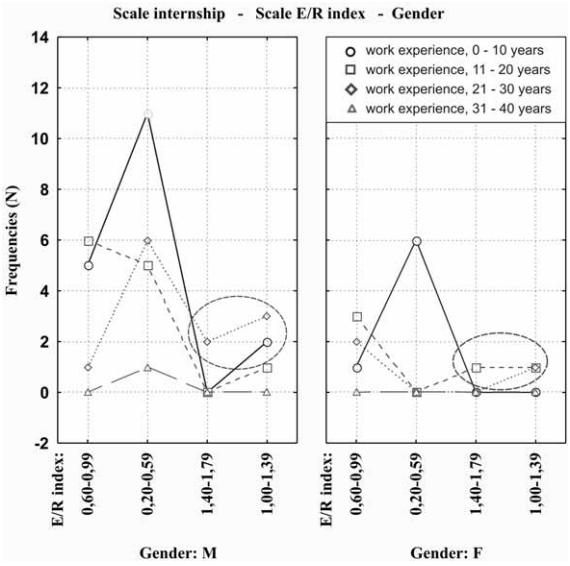

Fig. 3. Dependence of internship on scaled E/R index and gender.

Comparing E/R indexes to job complexity, it can be seen that the intensity of strain is similar for both genders, with heightened risk of stress at managerial working positions.

By comparing the calculated E/R index for every group of duration of internship (Cochran-Mantel-Haenszel Statistics; χ^2=13.214; df=9; p=0.1532) no statistically significant difference between the genders was revealed.

By testing the differences between the means of E/R index between age groups (4 groups by 10 years of difference) a significant difference has been revealed (F(3.57)= 2.88; p<0.05). Turkeys' post hoc test has shown significant difference between group 1 (21–30 years of age) and group 3 (41–50 years of age), at which the level of E/R index is higher in group 3 ($\overline{X}$=0.78; SD=0.35) than is in group 1 ($\overline{X}$=0.47; SD=0.14).

It can be stipulated than there is also a significant statistical difference between E/R index and job complexity of the interviewees (F(2.55)=9.16; p<0.05). Turkeys' post hoc test has shown that the managerial working posts differ from the specialist working posts (p=0.002), while level of E/R index is higher at managerial ($\overline{X}$=0.86; SD=0.29) than it is at specialist working posts ($\overline{X}$=0.48; SD=0.17).

When testing point-sum connected to »overcommitment« a statistically significant difference has been shown according to age of the interviewees (F(3.54)=5.58; p< 0.05). Turkeys' post hoc test has shown significant difference between group 1 (21–30 years of age) and group 3 (41–50 years of age), at which the sum of points connected to »overcommitment« is higher in group 3 ($\overline{X}$=

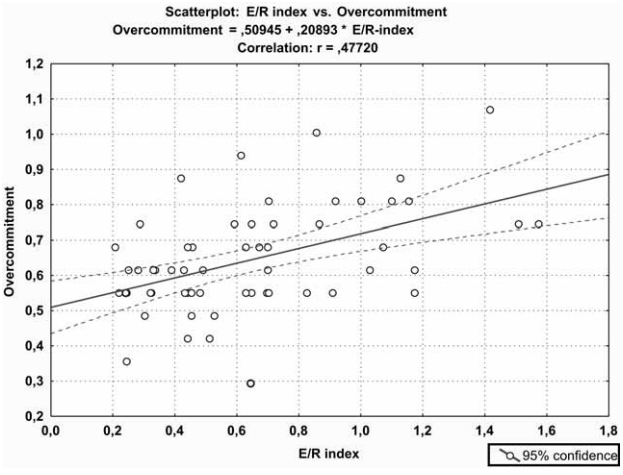

Fig. 4. Relation of E/R index to overcommitment.

TABLE 4
RESULTS OF REGRESSION ANALYSIS FOR E/R INDEX AS A DEPENDENT VARIABLE

N=(58)	Regression Summary for Dependent Variable: E/R index (E-R model.sta) R=0.61279236 $\overline{R}$=0.37551448 Adjusted $\overline{R}$=0.34082084 F(3.54)=10.824 p<0.00001 Std. Error of estimate: 0.27553					
	Beta	Std.Err. of Beta	B	Std.Err. of B	t (54)	p-level
Intercept			0.876945	0.498629	1.75871	0.084292
Age	–1.36772	0.493386	–0.049654	0.017912	–2.77210	0.007626
Internship	1.57838	0.491026	0.058306	0.018139	3.21446	0.002207
Overcommitment	0.43782	0.112789	0.064757	0.016683	3.88171	0.000285

16.29; SD=3.09), than it is in group 1 ($\overline{X}$=13.36; SD=3.13). In the testing of other parameters no significant difference in the means was found.

Gained coefficients of determination for the three independent variables (age, internship and overcommitment) describe 37.55% of the variance of E/R index. Beta coefficients of all three variables show statistical significance, which can be seen on multi-variable regression analysis in Table 4.

Graphical display on Figure 4 shows relation of E/R index to »overcommitment« which is expressed by sum of points, while holding age and internship on mean level. Overcommitment shows moderate positive correlation (r=0.477; p<0.05) with E/R index. E/R index has shown weak negative correlation to age of the interviewees (r=–0.303; p<0.05), while internship and overcommitment were held on mean level. Also, E/R index has shown weak positive correlation do internship (r=0.368; p< 0.05), while other variables were held on mean level.

By determining the connections between E/R index and questions E3, E6 and R13 from the questionnaire a statistically significant positive correlation has been observed to the »business responsibility« (q. E3, r=0.75; p<0.01) and »growth of job complexity« (q. E6, r=0.73; p<0.01). To variable »job safety« (q. R13) E/R index shown no statistically significant correlation.

Discussion and Conclusions

Mental stress is a subjective reflection of emotions of individuals which's intensity/level can be valuated by analysis of their statements. This research represents fist of its kind to be undertaken on forestry experts in Croatia. Results have shown that almost every fifth interviewee is exposed to mental stress, or that there is a discrepancy between devoted effort and achieved reward at every fifth interviewee.

Most important conclusions are:

- Women are under stronger mental pressure at work than their male colleagues are, and they are more dedicated to fulfilling job obligations (according to the average of the sums of point connected to »overcommitment«).
- Women with shorter duration of internship and life age (compared to their male colleagues) perform more complex work functions, but also earlier meet with mental stress as a result of the discrepancy between devoted effort and achieved reward.
- Third age group, which comprises out of experienced employees on managerial positions, is more exposed to mental stress than it is the case of their younger colleagues who are most often placed at general working positions.
- High values of E/R index, and accordingly high mental stress levels, mostly depends upon »overcommitment«, and out of which it can be concluded that high degree of devotion to job is in most of the cases not followed by an adequate reward, which strongly increases the risk of stress occurrence. This phenomenon is mostly pronounced at managerial positions.
- Regardless of age and gender, risk of mental stress grows with increase of job complexity.
- »Job safety« as a variable is not a cause of heightened mental stress because 75.86% of the interviewees is employed on permanent basis.

In the connection to the applied method, it can be concluded that on the basis of gained results relating to internal connection of the elements of the questionnaire, the used modified Chinese version of ERI questionnaire has shown to be most suitable instrument for measuring mental stress at forestry experts. For more complete evaluation of the applied method a larger sample survey should be done, and it should be repeated in intervals – a time series research.

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OCJENA RAZINE STRESA KOD VISOKOOBRAZOVANIH ŠUMARSKIH STRUČNJAKA

SAŽETAK

U radu se iznose rezultati ispitivanja šumarskih inženjera na rizik od pojave mentalnog stresa u njihovu svakodnevnome radu. Istovremeno, ocjenjuje se prikladnost i pouzdanost u istraživanjima korištenih metodoloških postupaka. Testiranje na rizik od stresa provedeno je e-mail anketiranjem ispitanika putem 23-dijelnog ERI (effort-reward imbalance) upitnika. Za ocjenu razine izloženosti mentalnom stresu korišteni su sljedeći pokazatelji: 1) ERI – razmjer uloženoga napora i vraćene nagrade i 2) predanost poslu. Ti su se pokazatelji analizirali u kombinaciji s demografskim podatcima ispitanika (spol, dob) te sa zahtjevnošću radne funkcije ispitanika. Upitnik je proveden nasumičnim odabirom šumarskih stručnjaka zaposlenih u javnom i privrednom sektoru. Analiza pouzdanosti tri sastavnica ERI upitnika pokazala je zadovoljavajuću unutarnju konzistenciju. Deskriptivna statistika napravljena je prema spolu i zahtjevnosti radne funkcije. Testiranje varijable »uloženi trud/dobivena nagrada« (E/R indeks) pokazalo je statistički značajnu razliku vrijednosti indeksa između muških ispitanika na rukovodećim poslovima i onih koji obavljaju općenite stručne poslove. Kod 18,97% ispitanika vrijednost je E/R indexa bila ≥1 čime se ukazuje na nejednakost uloženog napora i dobivene nagrade, a samim time i na rizik od razvoja mentalnog stresa. Multiple response tables pokazale su da ženski ispitanici u skupini s manje od 20 godina radnog staža manifestiraju simptome stresa ranije u odnosu na muške kolege jednakoga radnog staža. Regresijska analiza pokazale je ovisnost E/R indeksa u odnosu na starost, staž i predanost poslu. Po provedenom istraživanju ocjenjuje se da je primijenjena metoda u najvećoj mjeri pouzdan i primjenjiv instrument za ispitivanje mentalnog stresa kod šumarskih stručnjaka.

Appendix 1: Questionnaire

E1	I have constant time pressure due to a heavy work load.
E2	I have many interruptions and disturbances in my job.
E3	I have a lot of responsibility in my job.
E4	I am often pressured to work overtime.
E6	Over the past years, my job has become more and more demanding.
R7	I receive the respect I deserve from my superiors.
R8	I receive the respect I deserve from my colleagues.
R9	I experience adequate support in difficult situations.
R10	I am treated unfairly at work.
R11	I have experienced or I expect to experience an undesirable change in my work situation.
R12	My job promotion prospects are poor.
R13	My job security is poor.
R14	My current occupational position adequately reflects my education and training.
R15	Considering all my efforts and achievements, I receive the respect and prestige I deserve at work.
R16	Considering all my efforts and achievements, my work prospects are adequate.
R17	Considering all my efforts and achievements, my salary/income is adequate.
O1	I get easily overwhelmed by time pressures at work.
O2	I start thinking about work problems as soon as I get up in the morning.
O3	When I get home, I can easily relax and forget all about work.
O4	People close to me say I sacrifice too much for my job.
O5	Work is usually still on my mind when I go to bed.
O6	If I put off something that needs to be done today, I'll have trouble sleeping at night.