

**MEDICAL SURVEY OF THE STAFF WORKING
IN THE ŠKOCJAN CAVES, SLOVENIA**

**MEDICINSKI NADZOR OSEB ZAPOSLENIH
V ŠKOCJANSKIH JAMAH, SLOVENIJA**

VANJA DEBEVEC GERJEVIČ¹

¹ Regijski park Škocjanske jame, Škocjan 2, SI-6215 DIVAČA, SLOVENIJA

Izvleček

UDK: 551.44-057.16:614

Vanja Debevec Gerjevič: Medicinski nadzor oseb zaposlenih v Škocjanskih jamah

Jamska mikroklima se odlikuje po mnogih parametrih, ki v primeru dolgotrajnega delovanja, lahko povzročajo fiziološke spremembe v človeškem telesu. Poleg temperature, zračnega toka, odsotnosti sončne svetlobe in vlage, ki se spreminjajo glede na lokacijo in strukturo podzemnih prostorov, je prisotno tudi radonsko sevanje. Park Škocjanske jame, Slovenija, izvaja redne in kontinuirane meritve radona in hčerinskih produktov že pet let. Vse meritve opravlja Zavod za varstvo pri delu, Ljubljana. Obenem uprava parka vodi natančno evidenco o času, ki ga posamezniki prebijejo v jami, kar nam omogoča, da določimo maksimalno prejeto dozo sevanja, ki jo zaposleni prejmejo pri delu v času enega leta. V skladu z nacionalnimi predpisi in zakoni ter odločbo, ki jo je izdalo Ministrstvo za zdravstvo RS, Zdravstveni inšpektorat RS, je Park Škocjanske jame vzpostavil tudi redni medicinski nadzor zaposlenih v jami. Da bi preprečili zdravstvene probleme, ki bi utegnili nastati, se izvajajo podrobnejši zdravstveni pregledi, vsako leto ali redkeje. S krvnimi analizami se spremlja vpliv sevanja. V prispevku bo v kratkem predstavljen splošen pregled mikroklimatskih parametrov tako z vidika koristnih vplivov kot tudi dejavnikov tveganja.

Ključne besede: jamska mikroklima, speleoterapija, delovno okolje, ekološki monitoring, biološki monitoring, varstvo pri delu, radon.

Abstract

UDC: 551.44-057.16:614

Vanja Debevec Gerjevič: Medical survey of the staff working in Škocjan Caves

The cave microclimate is distinguished by many parameters that could underlie some physiological changes in human body when exposed for an extended period of time. Beside temperature, air-flow, the absence of sunlight and humidity, which vary according to the location and structure of the underground space, radon radiation is present as well. Park Škocjanske jame, Slovenia, has been performing a regular and continuous monitoring of radon and its daughter products for about five years now. All measurements are done by the Institute for Occupational Safety, Ljubljana. The accurate evidence of time spent in the cave is kept for every member of the staff. This enables us to combine the data with radon concentration and determine the maximum dose of radiation that one has received during one year working period. According to national regulation and law, stated by National Health Inspector and Ministry of Health, a regular medical survey has been established. Detailed medical exams are performed each year or less frequently in order to prevent health problems. Blood tests enable us to observe radiation impact. In the following work a short overview of microclimates impacts will be presented as health and risk factors.

Key words: caves microclimate, speleotherapy, working environment, ecological monitoring, biological monitoring, occupational safety, radon.

INTRODUCTION

The use of the caves is well known from prehistoric time, when people were using caves for several purposes (Horvath 1989). Underground spaces used in the past mostly as living places and shelters, started to present a special environment nowadays. Speleological and archaeological research, tourism and also medical treatment are activities performed in the caves. Each type of visit is regulated for organising purposes considering the type of caves microclimate as well.

There is no doubt that taking advantage of natural resources in the caves and beneficial effects if microclimate, presents an ecological burden for environment. In order to provide the caves and its microclimates as intact as possible, or at least with the minor human impact as possible, all the activities should be performed in a proper way.

Parameters of caves microclimate are measured for several purposes. Speleological research studies, nature protection and conservation are fields of great interest.

Special monitoring of such parameters is exerted in caves where observation of impact on human health is one of the priorities. Generally this is the case in tourist caves and in caves used for speleotherapy.

The activities in tourist caves are determined mostly by the pathways, interesting natural features and some show effects. In the case of speleotherapy people are taking benefits from the caves microclimate. Speleotherapy is a therapeutic method, which is used as a part of rehabilitation in curing bronchial chronic obstructive pulmonary diseases, asthma, allergies (Horvath 1989). It has been known for about fifty years now (Řičný 1986).

Time spent by a tourists in the cave is generally short, so we can assume, that the impact of caves microclimate is negligible. The other group of people, who are enjoying speleotherapy, in well determined underground spaces under medical supervision, never stays in the cave over an established period of treatment. In this case clinical exams are performed in order to be correlated with caves microclimate parameters. Such studies revealed a beneficial impact on health condition.

Both group of people visits the caves a few time in a year or even less. People working in the cave, and thus exerting an exposed activity for four hours or more daily, are tourists guides in show caves and medical staff in speleotherapeutic centres. The subject of our interest are professional guides who spent a majority of their working time in special working conditions.

For better and detailed survey medicine of work has established following activities:

ecological monitoring, where ecological burden on working place are evaluated such as noise, microclimate, radiation, etc.; biological monitoring, where evaluation of impact on workers is performed on basis of biological test as clinical exams; epidemiological monitoring, where health condition is evaluated for large groups of working population enabling us to find out the frequency of injuries and diseases with the causes and also the incidence and features in working places during working periods (Bilban 1999).

PAREMETERS OF CAVES MICROCLIMATE

The caves microclimate is distinguished by many parameters that could underlay some physiological changes in human body when it is exposed for an extended period of time. Beside

temperature, air-flow, the absence of sunlight and humidity, which vary according to the location and structure of the underground space, the radon radiation is present as well.

When the time spent in the cave, certified as speleotherapeutic centre, is limited by the therapeutic rules, we can describe a positive effect of microclimate due to a complex action of parameters. Thereby we could talk about health factors.

Constant temperature, slow air flow reduce the risk of cold or other respiratory disorders.

Absence of pollutants, micro-organisms and allergens favours the treatment of allergies.

High relative humidity, aerosols, ionisation, high CO₂ level result in easier breathing, purification of respiratory ways, anti-inflammatory effect.

Low doses of Rn radiation enables ionisation, stimulation of immune system and bio-positive effect which is described by induction of DNA repair enzymes, detoxification and synthesis of regulative polypeptides (Horvath 1989; Sandri 1999; Feinendegen & Bond & Sondhaus 1998)

Humidity, aerosols, ionisation and radiation forms a complex mechanism of caves self-purification which result in mechanical and biological cleanness of the air in the cave.

The environment as a whole exert a strong relaxing effect by modest light, absence of noise and stress (Horvath 1993).

Tourist guides working in the cave are performing working activities demanding good physical and psychological condition every day. The work itself is distinguished for its responsibility, concentration and specific working condition which vary according to the geological structure of the cave. Parameters which describe the working place exert a complex impact to human health, usually enlarged by several habits or health conditions usually present: smoking, overweight, modest physical condition, certain illness. Here parameters of caves microclimate could become also a risk factors.

Low temperature with fluctuations, strong air flow, high relative humidity favours cold or other respiratory disorders, rheumatism, unpleasant feeling which may be increased to the level of uncomfortable situation. Absence of daylight may also vary from discomfort to intolerable situation together with some eyes problems (Bilban 1999).

Regarding the Rn concentration strict measures were undertaken as required by national legislation. Regular monitoring is performed in order to establish the doses and to provide for regular screening of the radiation dynamic in the cave.

Radiation itself might result in health problems only when a dose absorbed is highly elevated or time of exposure prolonged (Župančič 1993). In our case Rn concentration has not resulted in elevated doses.

Physical effort result in higher degree of discomfort in a complex action of above mentioned parameters.

OCCUPATIONAL SAFETY

Park Škocjanske jame established some regulations together with Ministry of Health in order to provide an insight in dynamic of working conditions in the cave and thus enable the workers in the cave to work in a safe and pleasant way.

Internal regulation consists of rules regarding working clothes, gloves and shoes, which protect from cold, air flow, humidity and prevent injuries. Also strict evidence of time spent in the

cave is kept for each worker in order to survey the doses of radiation absorbed and also impacts from other parameters. The working process itself is organised in a way that could enable a change of working place in the case workers could be found in poor health conditions due to accidental overexposure or illness. After the time of recovery the former working duties are normally restarted.

External regulation has been prepared in co-operation with experts from Ministry for Health RS, Ljubljana and Institute of Occupational Health, Ljubljana and is performed through whole year.

Ministry of Health RS, Health Inspector RS, stated a decree on basis of the Law of sanitary inspection, dated in 1973 and 1985; and Law of ionisation radiation protection and special safety measurements in use of atomic energy, dated in 1984, by which Regional Park Škocjan caves is obligated to prepare an annual programme of radioactivity measurements, performed by a professional and certified institution which exert regular measurements of Rn concentration. There are continuous measurements of Rn concentration quarterly on seven locations and continuous measurements of concentration of daughter products quarterly on two locations.

Doses received by workers must be established by the Institute and reported to the Health Inspector together with findings of medical exams.

Each tourist guide is submitted to complete medical exam with eyes tests, X-rays, otorinolaryngological and general clinical exams are performed every year. Honorary workers are obligated to do the medical exams too. Blood tests in order to establish chromosomal aberrations have to be done every five years or more frequently if there are medical indications for it. Such laboratory test is a good indication of degree of radiation impact. The impact of other parameters could eventually be established indirectly by long-term studies and medical survey.

CONCLUSION

Caves microclimate is distinguished by many parameters that vary according to geological structure and shape of underground space. Such parameters are described as beneficial for health in determined caves and conditions, when time spent in the cave is limited.

Taking into account the population of tourist guides, who exert intensive activities daily under specific condition, the possibilities of injuries and diseases is increased. That is why regular medical exams are arranged together with some proper working procedures in order to avoid unpleasant health conditions.

In Park Škocjan Caves there is a special decree for tourist guides in caves, stated by Ministry of Health of RS, Health Inspector of RS considering the radiation protection which is used as guideline in preparation of programme for occupational safety of the staff working in the cave. Regarding all other parameters there are only medical guidelines applied in general working conditions usually used in managing of common working places.

Ecological monitoring in terms of radiation survey is done by the Institute for Occupational Safety, Ljubljana, as well as biological monitoring in terms of medical check-ups. Every year also an education programme is organised for workers in Regional Park Škocjan caves consisting of some legal information, radiation protection and biological effects of radiation.

In five years time of radon measurements in the cave there has not been a moment when some other precautions than ordinary have been required. Nevertheless monitoring and regular medical

survey will enable us to provide for suitable and safe working condition in the cave.

Epidemiological monitoring for quite numerous population of tourist guides in the caves has not yet been done. Perhaps some information exchange among other tourist caves in the world and international experts regarding the microclimate parameters measured, could lead to a formulation of common guidelines for such specific working group of people. This could be very useful in providing better working condition and safety in correlation with national regulations and laws not only for radiation protection but for other parameters too. An interesting assumption will then reveal some reference values for parameters in evaluation of working places in the cave.

Further constant medical survey of our workers and regular cave microclimate monitoring should result in better evaluation of working place and establishment of protective measurements. In that way good managing practice will result in higher level of safety for guides and visitors as well.

The quality of work on scientific basis will be applied to every day life for the benefit of health protection and nature conservation.

BIBLIOGRAPHY

- Bilban, M., 1999: *Medicina dela. ZVD - Zavod za varstvo pri delu*, p. 605, Ljubljana.
- Feinendegen, L.E., Bond V.P. & Sondhaus, C.A., 1998: *Low -Dose Irradiation Appear to Reduce Endogenous DNA Damage.- Radon und Gesundheit*, Peter Lang, p. 39-56.
- Horvath, T., 1989: *Possibilities of Spleootherapy in the Treatement of Children's Asthma.-Allergie and Immunologie, Interasma'89 Symposium on Speleootherapy*, p. 7-11.
- Řičný, D., 1986: *In Memory of Dr. Karl Spannagel.- Proceedings of Symposium on Speleootherapy, Blansko, The Czech Republic, February*, p. 338
- Sandri, B., 1999: *Speläotherapie-eine neue Form von Klimatherapie.- Speldok 6, Arbeitsuntrelagen zur Speläotherapietagung, Juni*, p. 3-10.
- Sandri, B., 1999: *Speläotherapie-eine neue Behandlungsform von Klimatherapie. In: Speldok-6, Arbeitsuntrelagen zur Speläotherapietagung, Juni*, p. 11-24.
- Župančič, A.O., 1993: *Iz varstva pred ionizirajočimi sevanji v Sloveniji. SAZU, ZRC Inštitut za medicinske vede*, p. 397, Ljubljana.

MEDICINSKI NADZOR OSEB ZAPOSLENIH V ŠKOCJANSKIH JAMAH

Povzetek

Jamska mikroklima se odlikuje po vrsti paramterov, ki kompleksno vplivajo na človeški organizem, še zlasti kadar je le-ta izpostavljen dolgotrajnemu delovanju posameznega dejavnika.

Same parametre lahko obravnavamo z vidika dejavnikov zdravja ali dejavnikov tveganja. V prvem primeru govorimo o speleoterapiji, ki je posebna oblika klimatskega zdravljenja astme, kroničnega bronhitisa, alergij. Terapija poteka pod zdravstvenim nadzorom v primerni jami. Zadrževanje v jami je v tem primeru kratkotrajno.

Turistični vodniki v jamah dnevno izvajajo aktivnosti, ki zahtevajo dobro fizično in psihično pripravljenost, koncentracijo in odgovornost.

Varstvo pri delu obsega vrsto ukrepov, ki zagotavljajo primerno delovno okolje in spremljanje psihofizičnega stanja delavca. V posebnih delovnih pogojih, kot je jama, pa se določeni dejavniki lahko izpostavijo kot obremenilni.

Nizke temperature, ki tudi nihajo, močan prepih, visoka relativna vlažnost imajo lahko za posledico nelagodje ali prehlad in revmatična obolenja. Primerna zaščita je delovna obleka. Tema in svetloba nizke intenzivnosti lahko poleg nelagodja vodita do bolezenskih težav z očmi. Seveda so vsi dejavniki v tesni povezavi z dejavniki tveganja za različna obolenja, s katerimi se delavec srečuje izven delovnega okolja: kajenje, debelost, slaba telesna pripravljenost. Le-ti lahko vpliv jamskih parametrov povečajo.

Kot eden od pomembnih parametrov je tudi radon. V Sloveniji je na področju varstva pred sevanji izdelana podrobna zakonodaja, ki jo upoštevamo pri zagotavljanju predpisov iz varstva pri delu.

Po priporočilih Ministrstva za zdravstvo RS, Zdravstvenega inšpektorata, se v Škocjanskih jamah izvajajo redne meritve Rn in potomcev. Meritve izvaja Zavod za varstvo pri delu, Ljubljana. Obenem se redno izračunavajo prejete doze za vsakega posameznega vodnika. Redni pregledi obsegajo klinične preiskave s poudarkom na pljučih in očeh ter krvne preiskave, kjer se s kromosomskimi aberacijami ugotavlja stopnja vpliva sevanja na organizem. Po zahtevah zakonodaje se poleg monitoringa zaposleni v jami redno izobražujejo s področja varstva pred sevanji.

Delovni proces je organiziran tako, da se lahko, v primeru ugotovljene obremenitve zaradi katerega od parametrov, delavca prerazporedi na ugodnejše delovno mesto.

Redno spremljanje parametrov, vključno z radonom, nam omogoča pregled nad dinamiko jamske mikroklimе in hitro oceno delovnih pogojev. Z medicinskim nadzorom spremljamo zdravstveno stanje zaposlenih. Ugotovitve bodo dolgoročno lahko prispevale k izboljšavam ukrepov za optimalizacijo delovnih pogojev ter pri povečani varnosti zaposlenih in obiskovalcev.