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KRS: 0000628361
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METHODOLOGY OF DISTANCE LERNING AND USAGE E-LERNING IN HIGHER EDUCATION

Beata Balcerowicz

Zakład Edukacji Medialnej, Wydział Nauk Pedagogicznych, Akademia Pedagogiki Specjalnej, Warszawa

balcerowiczbeata@gmail.com

Abstract:

Article is about distance learning - history, reasons to create, types and current usages. Text contains a description about specificity of the methodology, that is used in a distance learning lessons. Text is also about implementation and usage of distance learning in higher education. E-learning usages are described in examples of existing e-platforms. Article is based on the latest scientific publications about distance learning and contains schemes and tables made by the writer

Keywords:

e-learning, distance learning, digital media

Introduction

The most important value for the knowledge society in which we live is information. Information has become the source and cause of social and cultural changes that we are witnessing today. [1] Informatisation of the world has made access to information unlimited and (as a consequence) made informations are widely available. Along with the progress (computerization of the world), there is the problem of transforming many and often chaotic information into useful knowledge. [2]

Contemporary educational methods and techniques are trying to meet the needs of the developing knowledge-based societies and keep up with new technologies. The development has caused ICTs are present in every activity of our lives - fortunately, this development don't avoid education. Informatization of well-known forms of education has made it possible to improve them and allow at active participation of a mass audience at learning process despite many obstacles such as distance, costs and time.

Genesis and history of distance learning

Distance education is nothing new in history. Over the centuries, d-learning changed form, finally it take on form what we know now. [3] The media, through which information was tranmitted, changed along with the available technical means. Media evolved changing their form and destiny to become to one well known (us, modern) medium called the Internet.

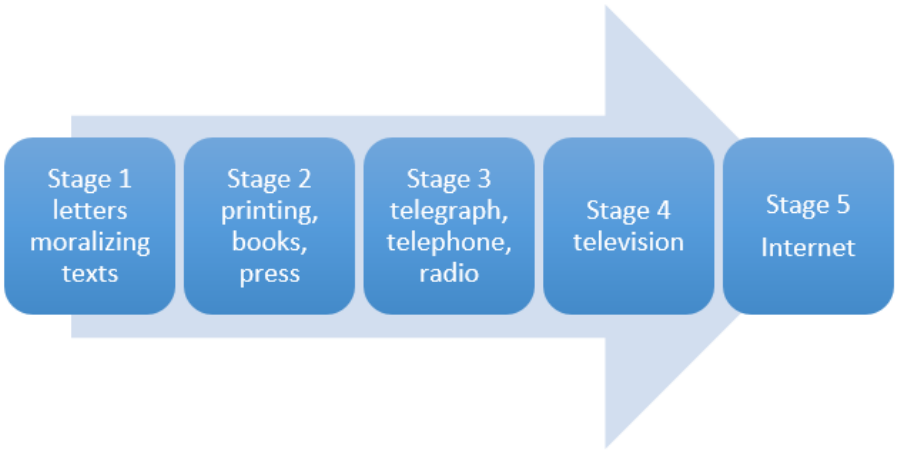

Figure 1. Media used in remote education.
Source: Own work based on source literature.

M. Tanaś believes that the history of remote education goes back 2,000 years ago, the beginnings of remote education are letters and instructive texts or text communicating knowledge. [4] According to other researchers, the history of distance education is much shorter and have only 300 years old. The substantiation for such a statement may be a systemic approach to issues related to education.

Human shared information in later periods of time with books and press. Because of invention of printing, the number of people who were able to read rised, as well as the popularity of readership and the general level of public knowledge.

Books are currently considered to be the oldest, the most durable, the most popular and accessible medium up to the present day. [5] Later, the first correspondence courses were conducted in the United States (1700) and Europe (1837). The courses consisted in sending materials for learning, exercises and tests between the students and the teachers delivered by post office. Mainly language courses and shorthand courses were offered. In Poland, the first correspondence courses were run by the Jagiellonian University (1776) and they were designed for craftsmen. The courses at a later time were very popular. A Flying University (1886) and Powszechne Kursy Uniwersyteckie were created in Warsaw.

The next breakthrough in distance education was the invention of radio-based communication. The effect of this invention was educational radio programs and educational television. Another breakthrough took place at the end of the 20th century. The Internet has connected all known media used for educational purposes and has made the world a global village in which information is transmitted at the speed of light. [7]

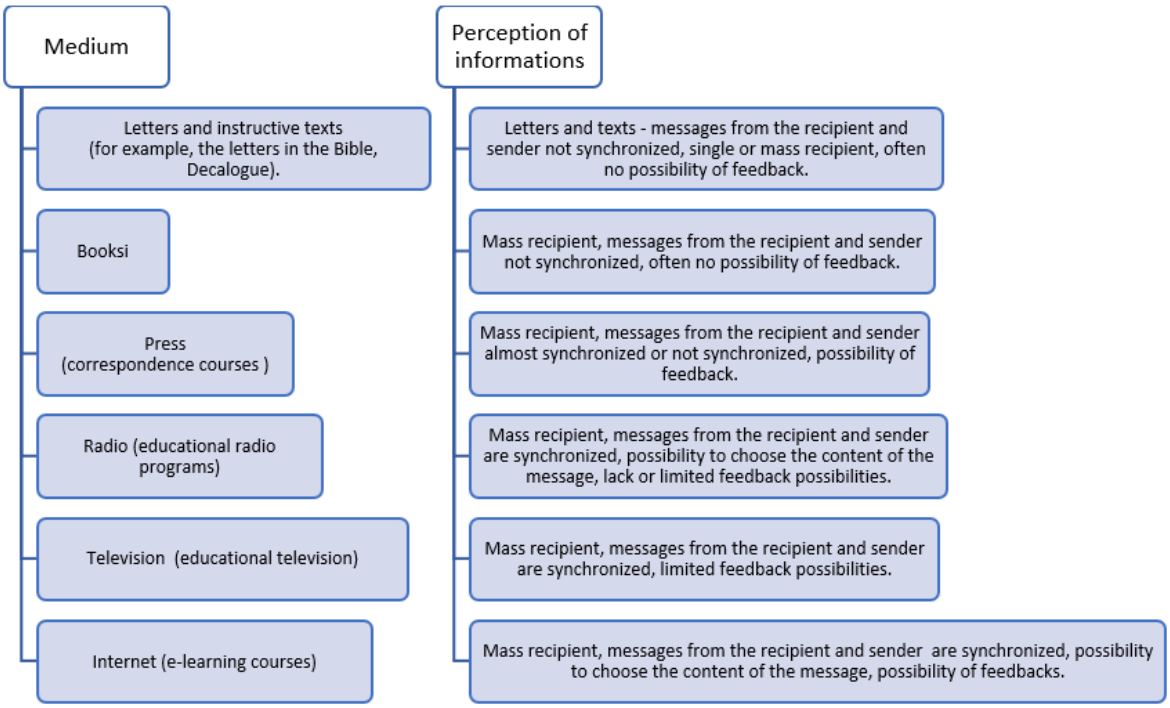

Figure. 2. Medium and perception of medial messages
Source: Own work based on source literature.

The main reason for the emergence of remote education may be desire to learn about the world, improve skills and clever use of available medias that transmitted information and means of communication.

Currently, as a result of combining the request for knowledge and ICT, we mostly use remote education in electronic form.

The term "e-learning" is a modern form of education, which includes various techniques and methods of learning. It's a synthesis of self-knowledge conquestion using available technical means with traditional methods. [8]

Participation in this kind of education means the teacher and his students face the necessity to develop new or improve useful skills. The multimedia form of content makes courses more attractive and that's why multimedia contents are often used in different environments. [9]

IT tools allow to enrich the learning process, they are a tool for improving and adapting the form of knowledge to personal and social needs. IT resources are particularly useful in adapting the learning process that meets the individual needs of the student. [10]

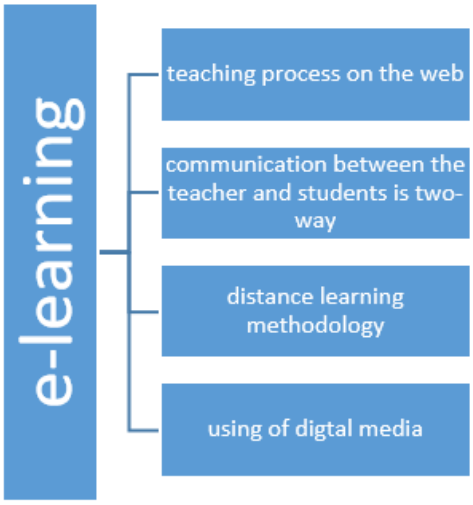

Figure. 3. Elements of e-learning
Source: Own work based on source literature.

Problems of distance education and learning with e-learning method

The issues of distance education include in the connections between andragogy, the specificity of distance learning, methodology and problems related to the teaching of information technology. [11] Due to the target group to which e-learning is addressed, attention should be paid to the principles of working with an adult student. According to the rules proposed by Rutkowska, the person who lead the course should be able to use the potential of the students' experience, create the possibility of immediate application of acquired theoretical knowledge in practice, support critical thinking and guide students in such a way that they would take action and then analyze the effects and draw conclusions by themselves. [12]

E-learning makes the current activities of the teacher and student changed. The teacher demonstrates an increased ability to activate students, have and share knowledge, supporte students in achieving their goals. On the other hand, students show an increased level of self-control and motivation to learn.[13]

When considering the subject of e-learning, attention should be paid to the 3xJUST rules, which have source in corporate e-learning and concerns the purposefulness of learning E-learning is a form of teaching often used in various types of training. These trainings contain information that is teach "just in case". That knowledge is rarely fully used then. A properly created e-learning course should be based on three pillars, which make the course content different, it positively affects the quality and effectiveness of teaching. [14]

Figure. 4. Just x 3
Source: M. Hyla – Przewodnik po e-learningu

E-learning, like any method and technique used in education, have advantages and disadvantages. In most sources, the authors present more advantages than disadvantages. M. Tanaś to advantages include: increase in the effectiveness of education, engaging the emotional sphere, affecting many senses, multimedia, interactivity, simulation, communication susceptibility to editing, content virtualization. [15] The main disadvantage of e-learning courses is the lack of motivation and self-discipline in learning from the students.

Tab. 1. Advantages and disadvantages of e-learning

Advantages	Disadvantages
Any time and length of learning (synchronicity and asynchrony of learning)	Required computer access
Modularity of content	Internet acess required
Increasing the role of the student in the education process	The ability to use a computer and other devices is required
Engaging the emotional-volitional zone	The costs of creating the course
Increase in learning outcomes	Limiting people-to-people contacts
Cost reduction	Possible technical problems with the students equipment
Individualization of the educational process	Possible lack of motivation and self-discipline of students
Easy supervision of learning progress	
Possibility to make lessons for many students	
The effectiveness of training	
The ability to quickly edit the content of the course	

Source: Own work based on source literature.

E-learning is included in the active forms of learning, which is promoted in the Lifelong Learning initiative. The aim of the program is to support education and learning and improve the quality of lifelong learning. [16] Due to rapid changes, knowledge quickly becomes obsolete, so it's valued practice to constantly check and update it. The latest information can usually be found on the Internet, so the idea of distance education and the idea of e-learning are part of Lifelong Learning.

Due to the popularity of distance education, new professions have been created. To the new professions we can include educators of remote education and media educators. [17] Their tasks include creating courses, adhering to the rules of teaching in distance education and leading lessons on the platform. Didactics of remote education are often teachers who leads an on-line course. They can be called mentors, tutors or trainers because they have

the knowledge and function of the moderator of the teaching process.

However, quoting the words of W. Okoń: „didactics is the science of education in self-education, their goals, content and methods, means and organization" [18] it can be said that everyone is, in some sense, a didactic of their learning process, because of indywidual choice of means, methods and techniques of science.

In the opinion of B. Siemieniecki, it is a mistake to transfer general didactic principles to the field of remote education. The error is from the results about belief about the invariance and similarity of the world around us with the virtual world. [19]

The application of distance education in higher education

Distance education via the Internet is the most effective form of remote education. Internet resources are a copy of the intellectual achievements of humanity, and a contemporary teacher can use them all. [20] E-learning and b-learning courses are often used as a supplementary form of stationary classes at universities. Students comply the criteria of a model recipient of remote courses.

E-learning and blended learning has found a wide usage in Polish higher education. The remote way of education successfully took place at the Warsaw University of Technology, which enables participation in extramural engineering studies. The OKNO project is operating continuously since 2001. [21]

As a result of the activity of the University of Warsaw, Centrum Otwartej i Multimedialnej Edukacji (COME) was established. COME mission is to expand access to university education for all interested. COME provides online courses and conducts post-graduate studies in the e-learning formula. [22]

In 2005, the Jagiellonian University created Centrum Nauczania Zdalnego They support the development of new teaching methods and forms as well as the promotion of academic e-learning. [23]

Another example of the use of e-learning in higher education is the Centrum e-learningu AGH Thanks to the Center's activity, students can use online textbooks to learn mathematics, physics and chemistry and a platform that provides teaching materials, forums and video materials. [24]

The e-learning platform of the Warsaw School of Economics is being systematically developed. The platform is intended for lecturers and students. Platform includes a virtual journal, discussion forum, tests, teaching materials and many other modern solutions. The platform has been adapted to the needs of the university and with its development, the quality of education increases. [25]

Summary and conclusions

I should admit M. Tanaś, who in 1997 wrote: "The computer has already become an instrument of everyday professional work, entertainment, communication and science". [26] Computer-aided learning is a common standard that we are happy to use. E-learning courses allow for convenience, time saving and individualization of the learning process. It is worth noting that e-learning, despite its many advantages, also has disadvantages such as limiting interpersonal contacts or lack of motivation among students. The use of e-learning courses

at universities allowed to eliminate these disadvantages and fully use the potential of distance learning.

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EFFECT OF INDEPENDENCE FROM THE SYNTHETIC DRUGS ON TACTILE DISCRIMINATION AND SURFACE FEELING IN THE UPPER LIMBS

Anna Fyda*, Rafał Uciński, Dariusz Górka, Michał Trzęsicki

Zakład Medycyny Sportowej i Fizjologii Wysiłku Fizycznego, Wydział Nauk o Zdrowiu, Śląski Uniwersytet Medyczny w Katowicach

*aniafyda@interia.eu

Abstract:

Synthetic drugs is a common name for various types of products containing psychoactive substances that are not on the list of prohibited substances, controlled by the law on counteracting drug addiction. The research group consisted of 15 addicts, using boosters for a minimum of one year. The control group consisted of 15 healthy people who never used drugs or other psychoactive substances. The addicted persons stayed in closed addiction treatment centers and did not consume any psychoactive substances for at least 4 months. After analyzing the obtained results, statistically significant differences were found ($p < 0.05$) in the feeling of people addicted to boosters in relation to healthy people. In addition, differences in the surface feeling between the dominant upper limb and the non-dominant side were observed. The use of synthetic drugs disturbs superficial feelings and sensory discrimination in the upper limbs.

Keywords:

synthetic drugs, discrimination, feeling, touch, upper limbs

Introduction

Synthetic drugs is a common name for various types of products containing psychoactive substances that are not on the list of prohibited measures, controlled by the law on counteracting drug addiction. Thanks to this, synthetic drugs are generally available narcotic substances and, for the most part, legal ones have become very popular in recent years. The respondents admit that they use drugs deliberately. It is mainly caused by a desire to break away from reality, to forget about everyday problems, to relax or just to have fun. In these studies, it was decided to check how prolonged use of drugs affects the nervous system, because there are not many studies confirming the influence of drug use on the central neuromuscular control system, which is caused by the difficult access to people addicted to these substances. Synthetic drugs is one of the most popular and relatively new pseudo-drugs on the market. They are substances characterized by a variety of chemical structures, but their common feature is that their task is to act on the nervous system in a manner similar to drugs considered illegal. They have both excitatory and hallucinogenic effects, but also similar to the popular cannabis. Unfortunately, substances advertised on the Internet as

legal highs are often fertilizers for plants, moisture absorbers, or other substances that act in a very toxic way on the human body and are unfit for consumption.

The use of psychoactive substances can lead to many negative health consequences, some tragic consequences, such as cardiac arrest leading to death. In 2013, in Poland, 207 people lost their lives because of this (mortality per one million people was 7.6). In comparison, in the same year in the EU this coefficient reached the value of 17.3, the highest in Estonia - as many as 126.8, and the lowest in Romania - 2.2 [1].

The aim of this work was to check the impact of using legal highs on discrimination sensory and superficial feeling in the upper limbs.

Material and methods

The research was carried out on a group of 30 people. The research group consisted of 15 addicts, using synthetic drugs for a minimum of one year. The control group consisted of 15 healthy people who never used drugs or other psychoactive substances. The addicted persons stayed in closed MONAR addiction centers and did not consume any psychoactive substances for at least 4 months. The average age of addicts (group D 28.4 years), and for healthy people (group Z 23.9). The mean addiction time was 9 years (MIN: 2. MAX: 18). The average abstinence time was 6.93 months (MIN: 4, MAX: 18).

Before the experiment, the procedure of measurements was explained in a way that was understandable for them, and they were asked to fill out a questionnaire, which allowed them to exclude people who did not meet the test requirements from the research group. To assess the sense of touch, the technomex WEST-HAND hand tester was used.

The meter consisted of 5 monofilaments of various sizes. Monofilaments differed in relation to the applied force in grams and occurred in sizes: 0.07; 0.2; 2; 2/3 and 4.

During the test, the subject was in a lying position, comfortable with eyes closed. The examiner applied a monofilament to the test finger, starting from the lowest basis weight, to the highest one. The subject's task was to report to the examiner as soon as he felt the pressure on the tip. The lowest result that the patient was able to sense was recorded. Then, a similar test was carried out on the remaining fingertips of the dominant and non-dominant upper limb, and the results for each limb were averaged.

To assess sensory discrimination, a two-point discriminator was used that allowed the sensation of distance between two points to be examined. The tests were performed in the upper limb dominating and not dominating on the dorsal surface of hands and fingers. The two-point discriminator is a disk ending in pairs of double needles that are located at different distances from each other (From 1 to 25 mm). The study was conducted by two researchers, Researcher X and Researcher Y. Each of them performed three measurements for each of the fingertips.

During the test, the subject was lying on the couch with his eyes closed. The task of the researcher was to apply the discriminator to the finger of the examined subject starting from the shortest distance, until the moment in which the subject said he felt two points. The lowest result that the patient was able to sense was recorded. Then, a similar test was carried out on the remaining fingertips of the dominant and non-dominant upper limb, and the results for each limb were averaged.

The obtained results allowed to calculate averages and statistical analysis. The statistical analysis was based on Microsoft Excel 2010 and the statistical statistical package Statistica 13.1. With the help of Statistica 13.1., analysis of basic descriptive statistics was performed, and statistical significance of the obtained results was calculated using the Student's t test. The level of statistical significance was set at $p < 0.05$.

Results

Sensory examination of superficial

Figure 1 presents a comparison of the results of superficial examination of the left upper surface of the dorsal hand and fingers with the WEST HAND innervation tester in addicts addicted to highs (group D) compared to healthy people who never consumed any psychoactive substances (group Z) .

Markings in figure (1-5 in fact have their impact on results in grams, where 1 means the lowest value - 0.07, while 5 the highest value - 4. It should be remembered that the lower value means the perceptibility of a thinner monofilament, and therefore a better feeling. On the other hand, the higher value means feeling worse.

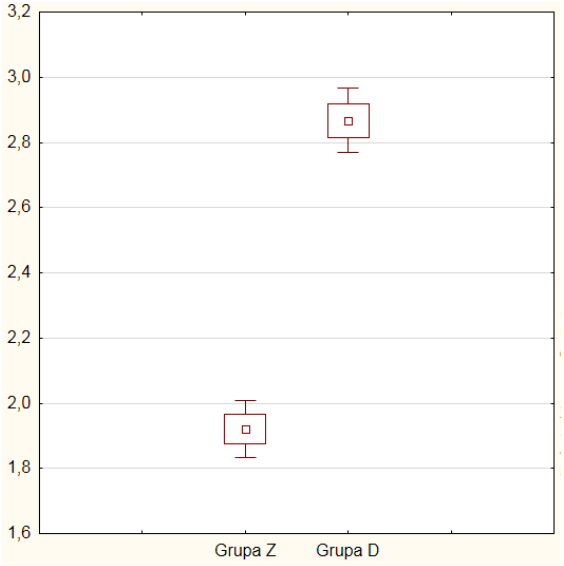

Figure 1: Sensory examination of superficial left upper limb
Source: own calculations

The graph shows significant differences between the results for the group of addicts compared to healthy people.

For the healthy group, the average score was 1.92, and the values achieved ranged from 1 to 3. In addicts, the average score was 2.87 and the results achieved fluctuated in ranges from 2 to 4. It follows that addicted people they were not able to sense the thinnest monofilament.

Statistical analysis showed statistically significant correlations between the results of addicts and values for healthy people ($p = 0.00001$)

Figure 2 presents a comparison of the results of superficial examination of the right upper surface of the dorsal hand and fingers with the WEST HAND innervation tester in addicts addicted to highs (group D) compared to healthy people who never consumed any psychoactive substances (group Z) .

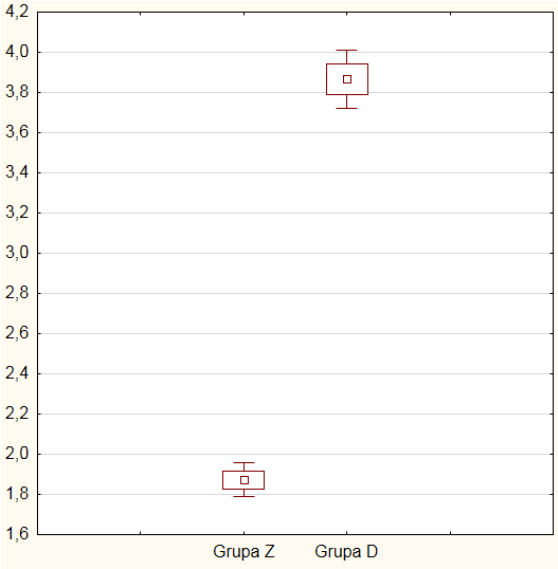

Figure 2: Sensory examination of superficial right upper limb
Source: own calculations

For the healthy group, the average score was 1.87, and the values achieved ranged from 1 to 3. In addicts, the average score was 3.87 and the results achieved fluctuated in ranges from 3 to 5. From this it follows that addicted people they were not able to sense the thinnest or even second grammage of the monofilament.

Statistical analysis showed statistically significant correlations between the results of addicts and values for healthy people (p = 0.000001)

Table 1 shows the correlations between the results for the left upper limb compared to the right upper limb of addicts.

Table 1. correlation between the results for the left upper limb compared to the right upper limb

LIMB	AVERAGE	SD	MIN	MAX	P
RIGHT(parent)	3,87	0,55	3	5	0,0002
LEFT	2,87	0,64	2	4	

Source: own calculations

The highest values were achieved by addicts in the right upper limb, which in 93% of respondents was the dominant limb. None of the subjects was in the state in the dominant limb to sense the first and second monofilaments. Statistical analysis showed statistically significant differences in the results between the dominant and non-dominant hand (p = 0.0002).

The average values for each of the fingers in the upper left limb of addicts are shown below in Figure 3.

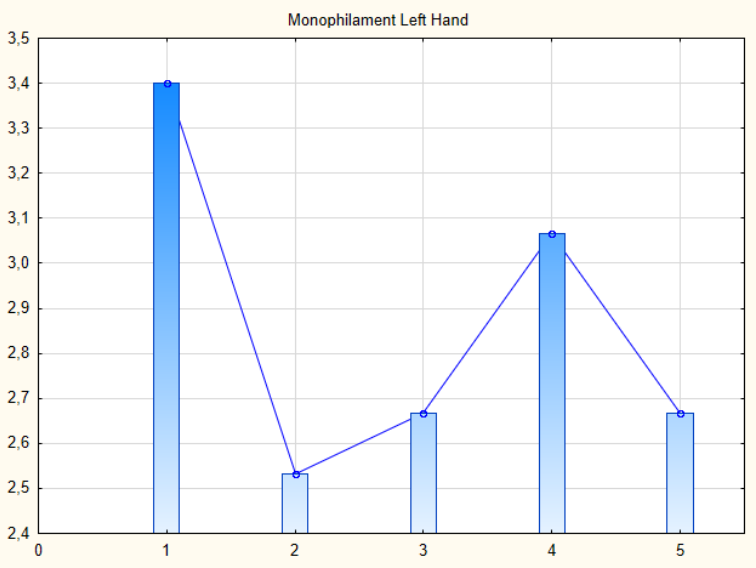

Figure 3: Mean values for each of the fingers in the upper left limb of addict
Source: own calculations

The highest value was shown by the finger 1, which is called the thumb. The smallest values, which are also a sign of the best feeling, were achieved by the second finger - the pointing finger.

Diagram 4 shows the average values of each of the fingers in the right upper limb of addicts.

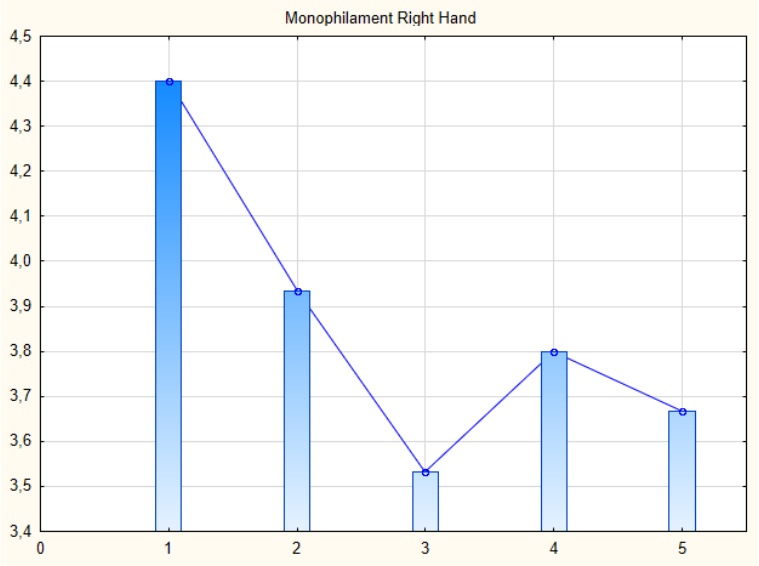

Figure 4: Mean values for each of the fingers in the upper right limb of addict
Source: own calculations

In the right (dominant) limb the thumb was also the highest. The average values for the first finger were as much as 4.4, which shows that the majority of respondents were able to sense only the last monofilament in weight. The best feeling was shown by finger 3.

Discriminatory feeling

Figure 5 presents a comparison of discriminative testing in the left upper limb on the dorsal hand and fingers using a two-point discriminator in people addicted to highs (group D) compared to healthy people who never used any psychoactive substances (group Z).

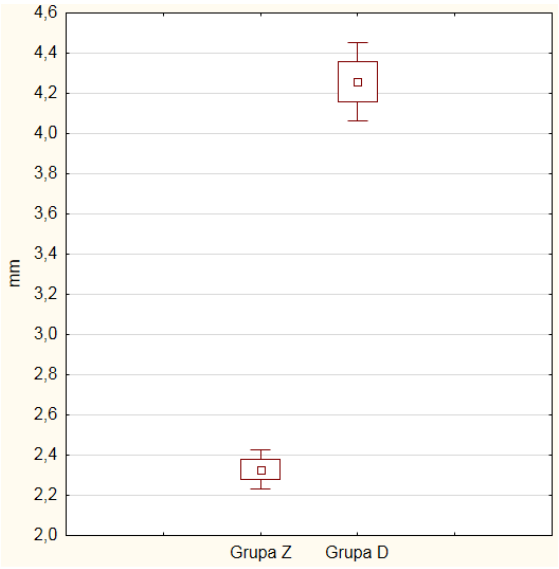

Figure 5: discriminative feeling in the left upper limb
Source: own calculations

The graph shows significant differences between the results for the group of addicts compared to healthy people. For the healthy group, the average score was 2.33 mm, and the values achieved ranged from 2 to 4. In addicts, the average score was 4.26 and the results achieved varied from 3 to 8 mm.

Statistical analysis showed statistically significant correlations between the results of addicts and values for healthy people ($p = 0.00000$)

Figure 6 presents a comparison of discriminative testing in the right upper limb on the dorsal hand and fingers using a two-point discriminator in people addicted to highs (group D) compared to healthy people who never used any psychoactive substances (group Z).

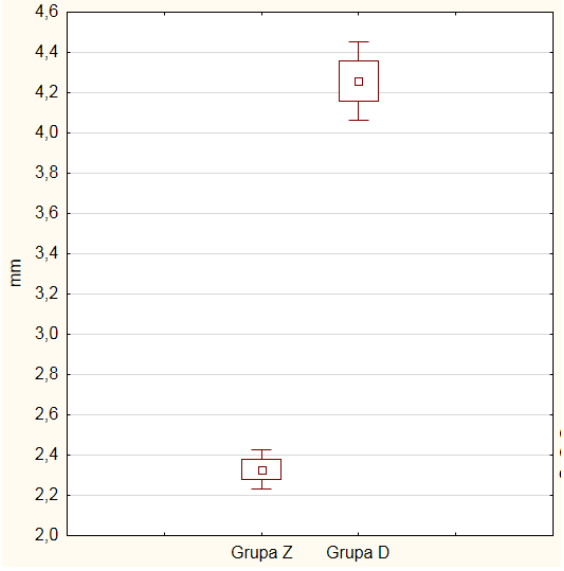

Figure 6: discriminative feeling in the right upper limb
Source: own calculations

The graph shows significant differences between the results of discriminatory feelings in the upper right limb in the group of addicts compared to healthy people. For the healthy group, the average score was 2.38mm, and the values achieved ranged from 2 to 4. In addicts, the average score was 4.24 and the results achieved varied from 3 to 6mm.

Statistical analysis showed statistically significant correlations between the results of addicts and values for healthy people (p = 0.00000)

Table 2 shows the correlations between discriminatory feelings for the left upper limb compared to the right upper limb of addicts.

Table 2. correlations between discriminatory feelings for the left upper limb compared to the right upper limb

LIMB	AVERAGE	SD	MIN	MAX	P
RIGHT(parent)	4,24	0,59	3	6	0,1971
LEFT	4,26	0,70	3	8	

Source: own calculations

Statistical analysis did not show statistically significant differences in the results between the dominant and non-dominant hand (p = 0.1971).

Below graph 7 shows the average discriminative sensation values for each of the fingers in the left upper limb in addicts.

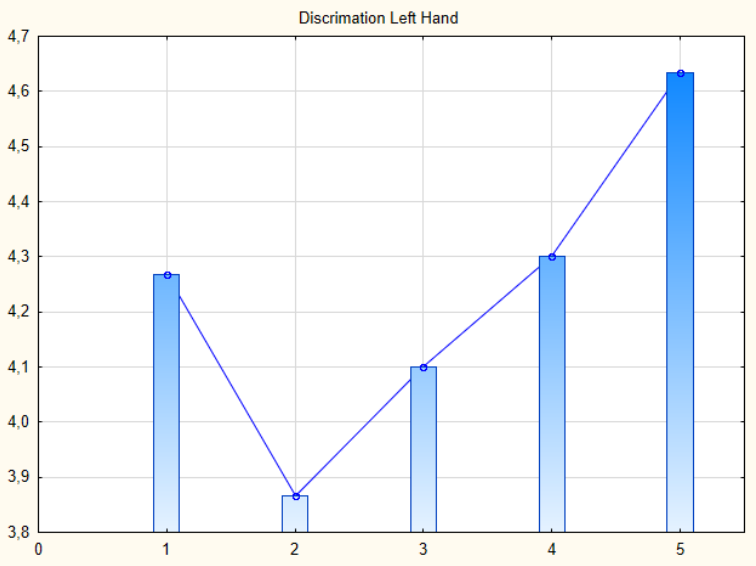

Figure 7 : average discriminative sensation values for each of the fingers in the upper left limb of addicts
Source: own calculation

The highest values were shown by the finger 5, which is a sign of the worst feeling. The smallest values were achieved by the index finger.

Below graph 8 shows the average discriminative sensation values for each of the fingers in the right upper limb in addicts.

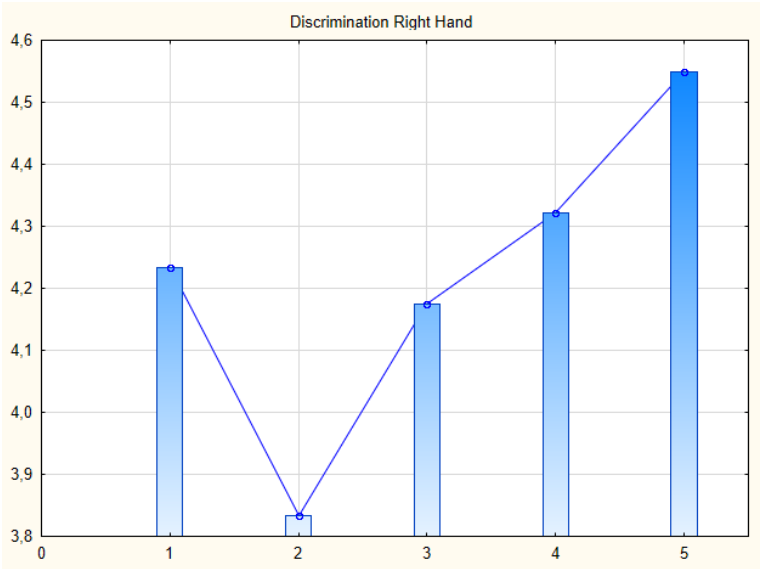

Figure 8 : Average discriminative sensation values for each of the fingers in the upper left limb of addicts
Source: own calculation

The highest values were shown by the finger 5, which is a sign of the worst feeling. The smallest values were achieved by the index finger.

Conclusions

After analyzing the obtained results, statistically significant differences were found ($p < 0.05$) in the feeling of people addicted to legal highs in relation to healthy people. It can be concluded from the conducted studies that the use of legal highs disturbs the superficial sensation in both upper limbs to a significant degree. In addition, differences in the superficial feeling between the

dominant upper limb and the non-dominant side were observed. The research confirms the toxic influence of the afterburners on the nervous system.

Unfortunately, there are no studies on the influence of afterburners on sensory functions. Perhaps because drug addiction is a group that is difficult to access or because there are "boosters" are relatively new substances and nobody has ever attempted to test this group of people.

The results, from which we can deduce that the afterburns damage the nervous system, giving the symptoms of superficial sensory disorder and sensory discrimination disorders can be compared to disorders resulting from long-term alcohol consumption. Addiction of alcohol damages the peripheral nervous system causing alcohol polyneuropathy, which gives the symptoms of sensory disorders. Perhaps it is similar in the case of drugs, and the conducted research will be a precursor to further experiments on this group of people.

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DESIGN THINKING – HOW ARE PRODUCTS BASED ON USER'S EXPERIENCE CREATED

Karol Dobrakowski

Department of Polymer Processing, Institute of Mechanical Technologies, Faculty of Mechanical Engineering and Computer Science, Czestochowa University of Technology, Czestochowa

dobrakowski@ipp.pcz.pl

Abstract:

This publication is a review, where Design Thinking methodology has been presented, which is the one of the tools supporting design based on the experience of users.
In the first part of article, the issues related to the history of this methodology have been described. Furthermore, the rules, which based on Design Thinking and results of its using have been discussed. In turn, the second part of this work has been devoted to issues presenting real application of Design Thinking. It contains also information about the stages of Design Thinking, through which teams should go during the whole design process.

Keywords:

Design Thinking, DTworkspace., Innovation, User`s Experience

Introduction

The Silicon Valley is probably known to most people in the world. Stanford University is located there, so it can be called the cradle of innovation. Such companies as: Apple, HP, GE and many others, which are the driving force of the global economy, comes from Silicon Valley. In the 1970s, David Kelley and other researchers at Stanford University began to work on understanding the process of creating products that became role models. They started from getting to know the products and behavior of environment, which uses this product.
this product.

Figure 1. Stanford University.
Source: https://pixabay.com/pl/stanford-university-california-1712774/

Through a deep analysis of the entire design process and time spent in the recipient's environment, they created Design Thinking methodology. After this discovery, David Kelley founded the IDEO design office, which is based on Design Thinking. The founder said that IDEO was born out of the sudden need to change the design thinking: client - the designer. It worked on principle that the company came with a ready product and required a nice package from the designer. Therefore Design Thinking methodology involves designers already in the phase of creating product concepts. Stanford University and the entire Silicon Valley is the first and largest Design Thinking center, and in 2004 the HPI School from Design Thinking in Berlin was also created [1].

But what is Design Thinking?

DT is a systematic process, that aims to increase the innovation of companies, enterprises and institutions. Idea of Design Thinking is based on understanding the needs and problems of the recipients of our product or service. Through the three assumptions that we must follow during the creation of the project process, we achieve the goals, we have set.

Assumptions of DT:

- ✓ Concentration on the user –in according to this assumption it is necessary to understand the conscious and unconscious needs of the target group. It will allow to get to know our recipients so that it will be easier to get information - what they really need.
- ✓ Interdisciplinary team - a team consisting of experts from various fields gives the opportunity to deeper look at a given problem. It gives the opportunity to work out a solution which will result from the work of different people, making it innovative and also reaching more people.
- ✓ Experimenting and frequent testing of hypotheses - building prototypes allows to test the functionality of the entire project so that a very valuable Feedback can be collected. By this approach, at the early stage of product creation errors in assumptions can be caught or functionality can be improved [2].

By applying these assumptions, the solutions created are:

- ✓ Human rule - design is a social activity, so all activities connected with should be focused on the needs and problems of other people.

- ✓ The rule of ambiguity - through this approach it is possible to go beyond some learned schemes, which affects the creation of new solutions.
- ✓ The tangibility rule - creating a prototype will allow to check the full functionality of a given solution. Thanks to that, the solution will be able to be tested in the recipient's natural environment.
- ✓ Bet on emotions - it is not always possible in our times to be the first in a given solution, but success is achieved by solutions, service, products that appeal to us emotionally. If we can create such a solution, it will certainly achieve a very big success [3].

What's going on in DT?

Created interdisciplinary team (consisting of engineers, sociologists, lawyers, etc.) implements step by step the process using tools and techniques that leads to the development of a solution ready for implementation. Thanks to going through all DT stages, it is possible to check the prototype in the environment of a given recipient, which makes it possible to change, delete and add certain functions. The creation of a prototype and testing it will give much faster and better commercial effects. Although at the beginning, it may seem that the time devoted to these two stages will be lost. This will save time and money. The main goal of the team is to generate a new solution that will be tested in its natural environment. However, if mistakes are made at the very beginning of the process, it will affect the failure and lead to the start of the process from the very beginning [4].

Where can we use Design Thinking?

In fact, Design Thinking can be used everywhere where we deal with people and problems that do not have a clearly defined solution or a rigid thought frames. Design Thinking can be used in a very wide range of fields. Examples of applications can be:

- ✓How to make one's stay in a given town more attractive?
- ✓What should the philharmonic repertoire addressed to young people?
- ✓How should the disabled people's environment look like?

And many other simple, but also very difficult issues can be solved using Design Thinking methodology [3].

Stages of Design Thinking

Design Thinking is a systematic process, based on several stages. The first two stages are based on getting to know recipients and also understanding their needs or problems, which they deal with in everyday life. The other three stages are a kind of extension of the first, but they are based on creating solutions and testing them in the recipient's environment [5,6].

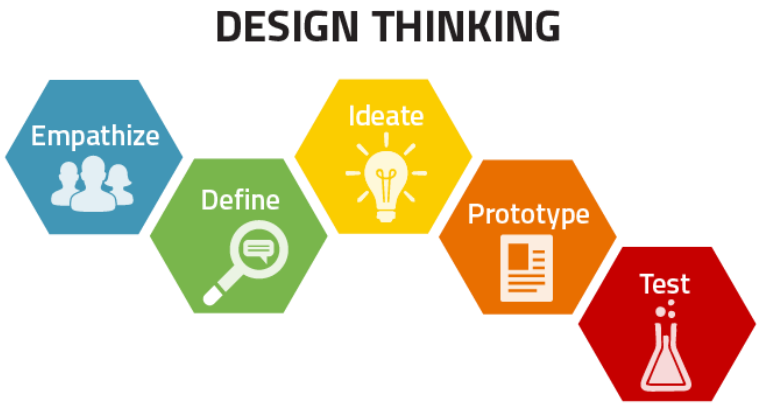

Figure 2. Design Thinking.
Source: https://www.compucom.com/services/design-thinking

Empathy - the first stage of the entire process, also called: for whom. This stage is the entry into the user's skin to understand the factors, which influence on the user during selecting products. Interviews and observations make it understand what is important to them and what their needs are. During empathy the user and his everyday life are the most important - we have to forget about our habits for a moment [5].

Definition - a stage also named: after what. At this stage, all collected information should be synthesized. The second stage should help to answers to the questions what the user needs, what would help him in functioning etc. The most important thing is that the second stage ends with determining how the user we are able to help [7].

Generating ideas - the most creative stage, also called: what. As the name says, brainstorming is most often used to pass this stage. Here, the most essential thing is to remember that the most important is the number of ideas - not their quality. In addition, it is worth saving all ideas, which gives the opportunity to reach for them at a later time [4].

Prototyping - the fourth stage of Design Thinking, called: how. During this stage, a prototype, that reflects the functionality of the solution, should be created. It is important to use basic materials for prototyping, in order to minimize costs [7].

Testing - a stage that is often overlooked and is very important, also called: whether. Thanks to passing through testing it is possible to obtain very valuable feedback. This allows for continuous improvement of a given solution, but it is important to remember not to try to sell the solution but only to hear its opinion [5].

Design Thinking gives the opportunity to create products, services or solutions that are based on getting to know the recipients. Thanks to this approach, it is possible to create a whole experience, therefore created solutions are a response to the observed needs or problems of users [7].

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MATHEMATICAL MODELLING OF THE ANTI-SURGE SYSTEM OPERATION

Andrzej Jaeschke
Instytut Maszyn Przepływowych, Politechnika Łódzka
andrzej.jaeschke@p.lodz.pl

Abstract:

Radial compressors are widely used in many branches of industry. Their failure can be a cause of serious financial losses. One of reasons that can lead to failure of compressor is the occurrence of the surge phenomenon. Therefore, the prevention against them is indispensable. A variety of anti-surge systems were proposed. Due to high costs of experimental validation of their operation a proper simulation techniques had to be developed. This paper presents an overview of available simulation techniques that can be used for validation of these systems together with an example of a generic derivation of one of the models.

Keywords:

Anti-surge systems, radial compressors, mathematical modelling

Introduction

Radial compressors are widely used in many branches of industry. Very often they are the core element of the production line. Therefore, their failure can cause significant financial losses. Flow instabilities are a group of phenomena that may be a cause of a severe failure of machines of this type. Emmons et al. [1] was the first to identify the unstable phenomena in the centrifugal compressors. Two main unstable phenomena have been identified by him: surge and rotating stall. Surge refers to a global flow fluctuations in the axial direction while rotating stall is a phenomenon of the formation of vortex structures which are stationary in a certain rotating frame of reference [2]. Both of them are the phenomena of high complexity causing significant problems with their numerical simulations and experimental investigation. However, the danger of damage of the machine as well as range of applications result in many works on this topic. The prevention of formation of flow instabilities (with main focus on the surge phenomenon) in the compressor is a role of so-called anti-surge systems.

Anti-surge systems

Since the work of Emmons identifying the dangerous unstable phenomena was published, a wide spectrum of anti-surge system was developed. They can be divided into several groups basing on different criteria. Firstly, they can be divided with respect to their working environment [3], [4] into systems for prevention during start-up, normal operation, and shutdown of the machine. Secondly, the systems can be divided based on the application of compressors for which they

prevent the creation of unstable phenomena. This division is not presented in this paper for sake of readability but it can be found in [4]. The last division can be done with respect to the principle of operation. Here, the systems can be divided into prevention, passive and active systems [4].

To explain the operation of the prevention system one needs to define so-called surge limit. In general, the surge phenomenon takes place when the mass flow rate through the machine is limited beyond certain value. This value is indicated by the surge limit, represented by the curve for variable rotational speeds of the machine. Unfortunately, due to the complexity of the phenomenon, there is a risk of unpredictable operation of the compressor in the vicinity of that limit without even crossing it, therefore an additional threshold is applied resulting in so called surge control line. The general idea behind the prevention systems is to prevent crossing the surge control line. This can be done for example by using a recycle valve that opens in case of surge danger to change the operation point of the compressor towards the stable operation regime. The valve opening is based on the measurements of certain parameters in the system. Instead of using the surge control line the prevention type can be based on early detection of surge symptoms. That approach is also based on the real-time measurements.

The second group, passive systems, are not based on any real-time measurements. They are in principle all methods that work towards shifting the surge limit as far from the desired operation point as possible. Those are mainly compressor's geometry modifications and optimizations.

The third group are the active systems that allow the safe operation of the compressor even behind the surge limit. Namely, they change the flow parameters actively, basing on real-time measurements of machine operation parameters, such that the machine operates in stable way. They require fast-response controllers, actuators and valves that also allow to precisely control their position. Although anti-surge systems of this type are still being developed and their components are very expensive comparing to previous two types, this one is the most efficient because it does not cause a significant loss of efficiency (prevention systems) and is independent of change in operation conditions (passive systems).

Finally, the anti-surge systems (prevention and active) can be divided with respect to the actuator. In most of the cases the role of actuator takes the recycle valve [4].

The mathematical modeling of anti-surge system is crucial due to complex calibration process of the system and high cost (and high danger level) of experimental tests. Therefore, usually most of developments and calibration process takes place in virtual space, only the final adjustments are validated by experiment.

PDE-based modeling

The most accurate models of operation of the compressing units as well as anti-surge systems are based on partial differential equations (PDE). Those models are usually based on the equations describing the dynamics of fluid flows. The most commonly used equations are Navier-Stokes and compressible Euler equations. They do and do not consider the viscosity of the fluid, respectively [5]. Proper choice of initial and boundary conditions as well as the geometrical domain representations are responsible for the modeling of the considered machine at the given operation point as well as of the operation of the anti-surge system.

The Finite Volume Method (FVM) and Finite Element Method (FEM) are two most commonly used methods for solving those equations. The main drawback of PDE-based modeling is an extremely high computational cost of solving the PDEs describing flow dynamics and lack of analytical solutions for them [5].

However considering both geometrical and temporal behavior of the flow is indispensible for simulation of passive anti-surge systems. It is very highly recommended for final (in virtual space) adjustments of other types of anti-surge systems as well.

Due to high computational costs there were not many approaches to PDE simulation of unstable flow phenomena in radial compressors. One of the approaches as well as the throughout description of the state of the art can be found in [6]. The PDE-based modeling of unstable phenomena prevention (rotating stall) was presented by Chen et al. in [7].

ODE-based modeling

The other group of methods are the models based on Ordinary Differential Equations (ODE) considering only temporal evolution of the flow phenomena. The numerical solutions of those equations are relatively cheap in sense of computational costs. They can be solved for example with use of Euler methods. Due to their simplicity and neglecting the geometrical setup they tend to be significantly less accurate then PDE models. However, their accuracy can be high enough for the first cycle of anti-surge systems development. The most commonly used ODE-based surge phenomenon model was proposed by Greitzer in [8] and validated experimentally in [9]. This model is still the one the most commonly used. Table 1 presents the overview of other common mathematical surge models with indication whether they are based on the Greitzer model or not. The next two sections present the Greitzer model of the surge phenomenon as well as its modification incorporating the influence of the anti-surge system on the compressing unit.

Table 1. Overview of mathematical surge models

Author	Year	Based on Greitzer model
Greitzer	1976	----
Hansen et al.	1981	yes
Fink et al.	1992	yes
Gradvdahl and Egeland	1997	yes
Willems	2000	yes
Meuleman	2002	yes
Helvoirt	2007	yes
Yoon et al.	2011	yes
Macdougal and Elder	1983	no
Elder and Gill	1985	no
Botros	1994	no
Badmus et al.	1995	no

Source: [6]

Greitzer model of surge phenomenon

Greitzer modeled the compressing system as three elements interacting with each other: compressor, plenum and throttle. Schematic compressing system according to Greitzer is presented in Fig. 1. Each element in the system is characterized by its geometrical dimensions such as length

L and cross-section area A, in case of compressor and throttle, or volume V in case of plenum. Pressure p and mass flow rate $\dot{m}$ at each component are the variables in the model. Subscripts c, p, t denote compressor, plenum and throttle, respectively.

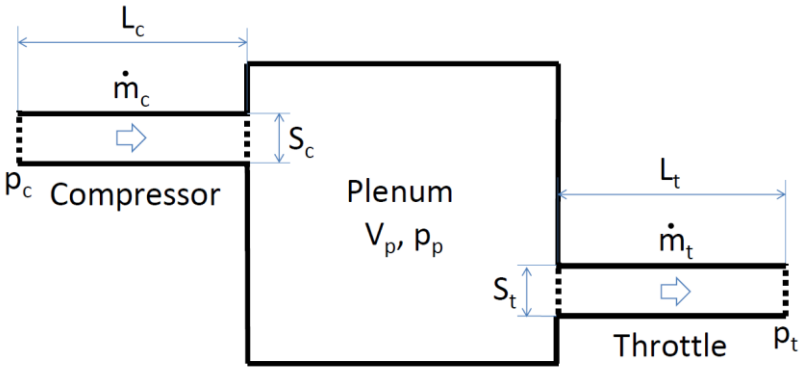

Fig. 1. Compressing system according to Greitzer.
Source: [6].

The model consists of four equations, out of which three are derived from mass and momentum conservation laws for each element of the compressing system and the fourth is a response-delay equation. The model after non-dimensionalization has the following form [10]:

$$\frac{d\Phi_c}{d\hat{t}} = B\,(\Psi_c - \Psi_p)$$
$$\frac{d\Phi_t}{d\hat{t}} = \frac{B}{G}\,(\Psi_p - \Psi_t)$$
$$\frac{d\Psi_t}{d\hat{t}} = \frac{1}{B}\,(\Phi_c - \Phi_t)$$
$$\frac{d\Psi_c}{d\hat{t}} = \frac{1}{\eta}\,(\Psi_{c,ss} - \Psi_c)$$

where $\Phi = \frac{\dot{m}}{\rho_a U_{tip} S_c}$ denotes dimensionless mass flow rate coefficient, $\Psi = \frac{2\Delta p}{\rho_a U_{tip}^2}$ - dimensionless pressure rise coefficient, $\hat{t} = t f_h 2\pi$ - dimensionless time coefficient, $B = \frac{U_{tip}}{4 L_c f_h \pi}$ and $G = \frac{S_c L_t}{S_t L_c}$ are the model parameters, ρ_a - the gas density, U_{tip} - impeller tip speed, $f_h = \frac{1}{2\pi} a_a \sqrt{\frac{S_c}{V_p L_c}}$ - Helmholtz resonator frequency and a_a- speed of sound.

In case of centrifugal compressors it is a general practice to omit the last equation due to its vague meaning for this kind of machines. Omitting the second equation is another widely applied simplification. In most cases the length of throttle is negligible and therefore response time of this component is infinitesimal. After those simplifications the model reads [6]:

$$\frac{d\Phi_c}{d\hat{t}} = B\,(\Psi_c(\Phi_c) - \Psi_t)$$
$$\frac{d\Psi_t}{d\hat{t}} = \frac{1}{B}\,(\Phi_c - \Phi_t(\Psi_t))$$

This form directly incorporates the compressor curve and the throttle curve that are responsible for the dependency of mass flow rate on pressure ratio and vice versa.

Incorporation of anti-surge valve in the model

The influence of the anti-surge valve on the system can be incorporated in the model by adding an additional outflow term in the second equation:

$$\frac{d\Phi_c}{d\hat{t}} = B\,(\Psi_c(\Phi_c) - \Psi_t)$$

$$\frac{d\Psi_t}{d\hat{t}} = \frac{1}{B}\,(\Phi_c - \Phi_t(\Psi_t) - \Phi_{t2})$$

The subscript t2 denotes the outflow through the anti-surge valve. The most important part from the point of view of anti-surge system development and modeling is the definition of the dependency of this outflow term on other parameters of the system, namely on the mass flow rate through compressor or the pressure in the plenum. Due to the technical problems with accurate dynamic measurements of the mass flow rate it is rather recommended to use the dependency on the pressure, namely:

$$\frac{d\Phi_c}{d\hat{t}} = B\,(\Psi_c(\Phi_c) - \Psi_t)$$

$$\frac{d\Psi_t}{d\hat{t}} = \frac{1}{B}\,(\Phi_c - \Phi_t(\Psi_t) - \Phi_{t2}(\Psi_t))$$

The definition of this dependency is a main obstacle in design and modeling of anti-surge systems. One commonly referenced form of this function was presented in [11] and validated in [12] for the DP1.12 blower. That approach assumes that the valve position is based on the optimal response to the Greitzer model parameters with taking into account the momentum of the valve. On the other hand, it is possible to consider here any other function that is reflecting the behavior of the analyzed anti-surge system.

Conclusions

Radial compressors are cores of many production lines in variety of industries. Their failure can stop the production and cause of serious financial losses. Surge phenomenon can be responsible for total failure of compressor. Therefore, a variety of anti-surge systems were developed. Due to high costs of experimental validation of their operation a proper simulation techniques had to be developed. This paper presented an overview of available simulation techniques that can be used development, tuning and validation of anti-surge systems.

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MONITORING OF SULFATE COMPOUNDS IN THE AIR

Justyna Jonik

Instytut Chemii, Wydział Nowych Technologii i Chemii, Wojskowa Akademia Techniczna, Warszawa

justyna.jonik@wp.pl

Abstract:

The aim of this work is the discussion of issues related to the monitoring of sulfur compounds in atmospheric air. I would like to characterize chemical compounds of sulfur, forms of its accumulation in the air, its circulation in nature and occurring chemical reactions. I will present its anthropogenic and natural sources and the influence of air pollution with sulfur compounds on the natural environment. Next, I will present methods, which can be used to identify gaseous pollutants in the air. The choice of these methods will be conditioned by their suitability for quantitative and qualitative determinations of sulfur compounds in the air. In this work will be a description of the equipment used for monitoring sulfur compounds.This description will include: construction, principle of operation and possibilities and conditions of use.

Keywords:

air pollutants, sulfur compounds, air monitoring, LIDAR

Introduction

Atmospheric air is very important for life on Earth. The most important life processes take place in the air, such as burning or oxidation [1].

The average composition of atmospheric air to a height of 13 km above the surface of the Earth is considered constant and is as follows: 78% of nitrogen, 21% of oxygen, 0.9% of argon, 0.1% of carbon dioxide, neon, helium, methane, krypton, hydrogen and xenon, and also variable amounts (at ppm level) of dinitrogen oxide, ozone and sulfur dioxide. Atmospheric air also includes mineral or organic components (dust, microorganisms) and other components that are emitted to it. All substances in the solid, liquid or gaseous state, which are not natural components of the air, or their content is higher than the average content in the clean air, we refer to as impurities [1,2].

There are two sources of the air pollutants: natural and anthropogenic. The main natural contaminants include volcanic activity, forest fires, decomposition of living organisms. In general, these are gases (sulfur dioxide, hydrogen sulphide, ammonia, carbon dioxide, carbon monoxide, hydrocarbons), as well as dust coming from volcanoes and desert areas. On the other hand, pollution resulting from human activity comes mainly from transport, agricultural activity, fuel combustion, mining or landfill [3].

The intensive economic development that raises people's living standards has a negative impact on the environment. The degradation of the natural environment and the growing awareness of the society about the role played by the environment in human life have contributed to the protection of

the environment with legal protection. This protection has found its place in international and community law as well as in the legal regulations of individual countries. The air, regarded as an element necessary for life of not only for human, but also for animals and plants, we must perceive as the good of nature, which as a result of further destruction will be exhausted. The effects of air pollution are definitely more dangerous than pollution of soils or waters, which is caused by the difficult to control possibility of air spreading [4].

The environmental protection must be based on real information about the state of pollution. In order to be able to take appropriate steps towards of air protection it must be monitored. We can define air purity as the sum of all pollutants. The measurement of gaseous air pollutants consists in their identification and the quantitative determination. These measurements are made using various specialized methods. To detect gas concentrations of air pollutants, local or remote sensing methods can be used. The collected information from these sensors is sent to the appropriate alarm centers. The analyzed informations allow to determine the level of danger. Environmental monitoring is therefore based on the detection, analysis, collection and sharing of data on contamination, environmental pollution and their impact on the natural environment [5,6].

Air pollution with sulfur compounds

The geochemical cycle of sulfur (the circulation of this element in the environment) is important for life and the environment on Earth. Sulfur undergoes reductive-oxidative reactions. It also occurs in individual stages on many oxidation states. In organic compounds, sulfur occurs in the most reduced form. It usually existed as thiol groups in which the sulfur takes the oxidation state -2[1]. The geochemical cycle of sulfur is depicted in Figure 1 [7,8].

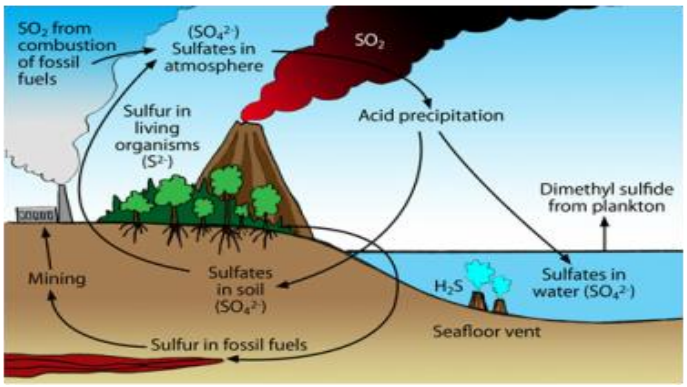

Figure 1. The global circulation of sulfur in the natural environment.

Source: Sulfur cycle, http://mannyker.weebly.com/environmental-science/sulfur-cycles, 15.05.2018.

The sulfur cycle in the last 100-150 years has become more dynamic. The reason for this phenomenon is human activity. Rapid industrial development, which brings with it increasing amounts of fuels burned, has become the main source of sulfur emitted into the atmosphere in the form of sulfur dioxide. An important issue is the increase in the oxidation state of sulfur as a result of human activity. The importance of this problem is quite high, because as it was mentioned above in biological processes, sulfur usually occurs in the reduced state [9].

The sulfur compounds accumulated in the atmosphere undergo various chemical reactions. The most common product of these reactions is sulfuric acid. Its presence in the air is one of the causes of acid rain [2]. An acid rain affects the life of living organisms, acidifying water reservoirs and soils. Sulphate ions contribute to outflows from water and soils of calcium and magnesium ions. The consequences of this process are associated with an increase in the concentration of hydrogen and aluminum ions. High concentrations of these ions are responsible for destroying forests. Acid rain contributes to the acceleration of corrosion processes, destruction of clothing and buildings [10].

The sulfur in the atmospheric air also takes the form of sulfur dioxide and sulfur trioxide. These compounds have a negative impact on the environment. So, it is important to assess the state of air pollution with these oxides. Natural sources are responsible for the emissions of small amounts of sulfur dioxide. Most of the sulfur dioxide emitted into the atmosphere comes from anthropogenic sources. The most sulfur dioxide emitted to the atmosphere comes from the combustion of hard coal (56%), crude oil and petroleum products (24%) [5].

Sulfur compounds in atmospheric air can undergo the following chemical reactions [11]:

a) oxidation of hydrogen sulphide to sulfur dioxide

$$2H_2S + 3O_2 \Rightarrow 2H_2O + 2SO_2 \quad (1)$$

b) oxidation of sulfur dioxide to sulfur trioxide

$$2SO_2 + O_2 \Rightarrow 2SO_3 \quad (2)$$

c) reaction of sulfur trioxide with water, which product is sulfuric acid

$$SO_3 + H_2O \Rightarrow H_2SO_4 \quad (3)$$

d) reaction of sulfur dioxide with water, which product issulfurous acid

$$SO_2 + H_2O \Rightarrow H_2SO_3 \quad (4)$$

e) oxidation of sulfurous acid to sulfuric acid

$$2H_2SO_3 + O_2 \Rightarrow 2H_2SO_4 \quad (5)$$

Methods of detection of sulfur compounds in the air

Measurements of concentrations of substances in atmospheric air are used to determine the degree of contamination of the air. For this purpose, the determined concentrations of gaseous and particulate pollutants are compared with the limit values. This action allows you to take appropriate steps, if you find inadmissible values of these concentrations.

Methods for monitoring pollutants in the air can be divided into two groups. The criterion for this division is the method of taking samples for analysis. The first group includes methods in which sampling takes place at the site of pollution. They are so-called local action methods – 'in situ'. The second group of methods includes remote detection methods. In this group of methods, the identification and measurement of the concentration takes place within a few hundred meters or even kilometers. These include the so-called 'stand-off' and 'remote' methods. The first group of methods is not characterized by good reliability and accuracy. These disadvantages were eliminated in remote methods. Choosing the right measuring technique allows monitoring atmospheric air over distances of several kilometers. Nowadays, optoelectronic methods emerge in this group of methods. The position they occupy results from a number of advantages, including measurement automation,

measurement reliability, measurement without the need to take a sample and the ability of different systems to cooperate in the detection, processing and transmission of measurement results.

Methods for determining impurities contained in the air in the place where they occur ('in situ') can be divided into chemical, biochemical, physical and physicochemical. However, in the case of remote detection methods, we distinguish two groups of methods. Methods – LIDAR (Light Detection and Ranging) and passive methods – LOPAIR (Long Path Infrared) [12,13].

Remote methods for the detection of sulfur dioxide

Methods of remote detection of atmospheric air pollutants are based on the interaction of electromagnetic radiation with matter. These methods are characterized by high detection, selectivity and speed of determination. They also allow you to identify the detected substance. The methods of probing the atmosphere with laser have gained great recognition [14].

In active methods LIDAR is used. Initially, they were used to measure basic parameters and meteorological phenomena. With the improvement of laser techniques and measurement principles, their use has been expanded.

Commonly used LIDAR are:

1. Scattering LIDAR - the principle of its operation consists in sending a strong laser pulse and then registering the return signal. This signal is the result of dispersion on aerosols or dust in the atmosphere of the primary beam. It is used to determine the composition of rain, clouds or fumes.

Scattering LIDAR in its structure contains a transmitter and an optical receiver. The laser transmitter is characterized by a single wavelength. The signal receiver is composed of a telescope and a detector and a filter whose transmission spectrum is matched to the laser spectrum. The whole apparatus is controlled by a computer. The generated light impulse must be characterized by such a wavelength so that it is not absorbed by atmospheric gases. The beam is directed along the optical axis of the telescope. The laser signal is dissipated in the atmosphere. Part of this signal reaches the measuring system as so-called echo. The returning signal is focused by means of a telescope on a photodetector, in which it is changed to a digital form and analyzed by a computer [15].

The time required for the return of the scattered signal can be used to determine the position of the scattering object. It can be determined by using the following equation [15]:

$$t = \frac{2d}{c} \rightarrow d = \frac{t \cdot c}{2} \tag{6}$$

where:

t – echo delay [s];

d – distance of the object [m];

c – speed of light [m/s].

2. Raman LIDAR –it is based on the phenomenon of displacement of the scattered radiation frequency on gas molecules. It allows identification and measurement of concentration of sulfur dioxide or hydrogen sulphide. Its construction is analogous to the construction of thescattering LIDAR. The receiver records only the signal for which the wavelength is shifted in relation to the wavelengths sent by the LIDAR laser. The great advantage of this type of LIDAR is the measurement of the absolute concentration of gaseous pollutants. This is possible by comparing the intensity of the Raman lines of the determined gaseous substances with the intensity of the nitrogen

or oxygen molecule lines, i.e. gases entering the atmosphere with constant and well-known concentrations [14].

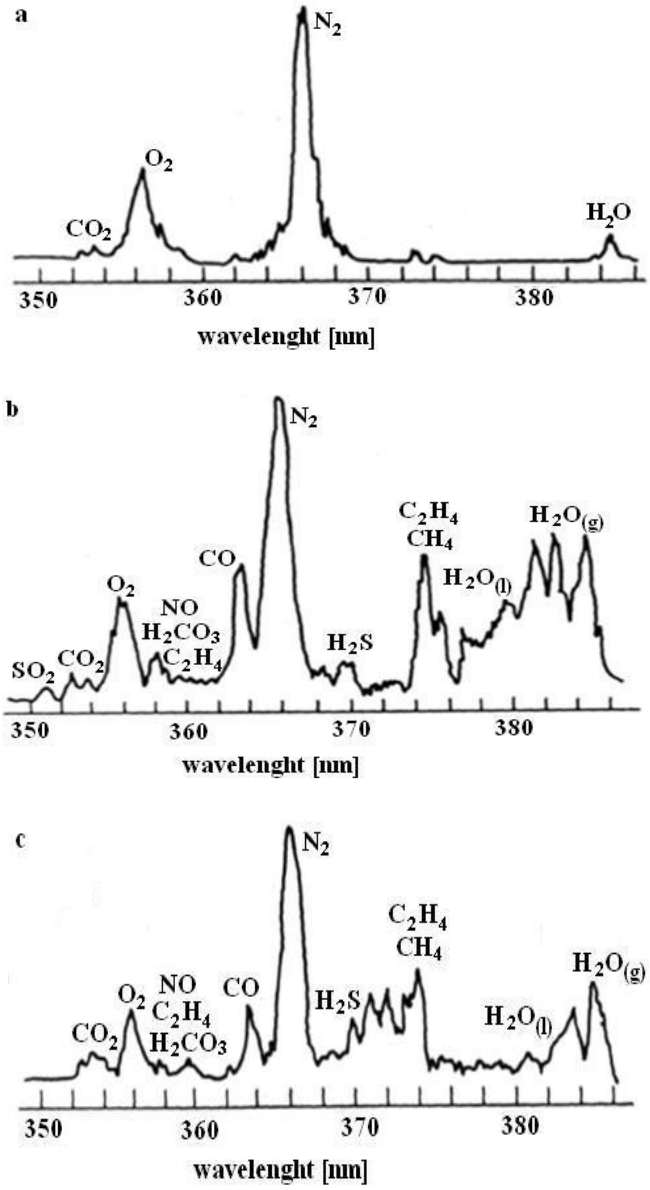

Figure 2. Raman spectra of a: clean atmosphere, b: smoke, c: exhaust; excitation with 337 nm nitrogen laser.

Source: http://www.fuw.edu.pl/~ajduk/wyklady/fmos.pdf, 11.05.2018.

Raman spectra are shown in Figure 2. It should be noted that in each spectrum we observe bands for nitrogen and oxygen molecules, which are used to determine the concentration of pollutants [15].

3. Differential absorption LIDAR (DIAL) is the most commonly used. The principle of its operation is based on scanning space with two beams. One of them is tuned to the absorption band of the test gas substance, and the length of the other is shifted in relation to the absorption band and is a reference beam that allows a quantitative concentration measurement. Figure 3 illustrates the idea of DIAL operation [12,14].

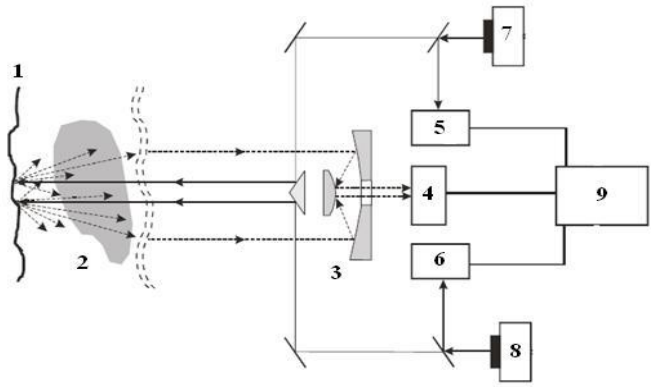

Figure 3. Scheme of DIAL (1: scattering surface, 2: methane, 3: transceiver, 4: detector D1, 5: detector D2, 6: detector D3, 7: laser He-Ne, 8: laser He-Xe, 9: signal processing system).

Source: A. Gietka, Z. Mierczyk, M. Muzal, Biuletyn WAT, (2006), Vol. 55, 21-55.

The D1 detector picks up the scattered beam. Two signals appear at the output of the detection element. The difference in the amplitudes of these signals depends on the concentration of the gas being determined. Detectors D2 and D3 are designed to control the power of generated radiation. That is why some of the laser radiation is directed to these detectors with the use of light-reflecting plates. DIAL allows for the identification and measurement of the concentration of the test substance. The measurement of sulfur dioxide concentration is possible at the level of 1 ppm [12].

Remote detection methods for gaseous pollutants were dominated by LIDAR methods. The development of laser technology, which made it possible to increase the quality of measurements, contributed to this. Today, the remote detection of gaseous air pollutants is based on active methods [13].

'In situ' methods for the detection of sulfur dioxide

The search for devices for the automatic detection of air gaseous pollutants results in the development of a new generation of instruments. These are sensor analyzers. These devices are based on a series of sensors that enable identification and measurement of the change in the concentration of a given substance in their environment. The response of sensor to the appearance of a substance or a change in its concentration in its environment may be chemical or physical. It also happens that a given sensor cannot be included in one of these groups. Basic sensor groups are: electrochemical, electrical, gravimetric, thermometric, magnetic, biochemical and optical [12]. Sensors are used to detect sulfur compounds [12,14]:

1. Electrochemical – the idea of their operation is based on the electrochemical reactions of the test substance. These changes occur in miniature vessels. During the reaction an analytical signal appears. The electrodes used in this group of sensors are suitably adapted to the detection of selected chemical substances. Inertial, chemically active and modified electrodes are used. Due to the electrochemical reaction, these sensors are divided into: potentiometric, voltammetric, coulometric and conductometric.

2. Electric – based on changes in electrical parameters of solids(conductivity, potential, charge). These parameters change under the influence of chemical compounds from the gas phase

to the solid surface. In order for the sensor reaction to be possible it must first absorb the substance being measured on the active surface of the sensor. From this group of sensors for the detection of sulfur dioxide, semiconductor sensors based on metal oxides are used.

3. Fotoacoustics – which are classified as gravimetric sensors. The principle of their operation is based on the processing of changes in the mass of the detection system into an electrical signal. Piezoelectric materials are used here. The substance is determined by absorbing on the surface of the piezoelectric and causes its mass change. As a result, there is a change in the speed of propagation of acoustic waves on its surface.

4. Optical - in these sensors, the appearance of a chemical substance changes the luminous flux. The detection element is a layer of an optically active chemical compound. This compound, under the influence of interaction with the tested substance, changes its optical properties. Depending on the cause of changes in luminous flux parameters, spectrophotometric, luminescent and optothermic sensors are used.

The methods of gas detection in the air in the place of their occurrence include photoacoustic methods. These methods are based on the phenomenon of absorption of infrared radiation. The idea of this method is to measure gas pressure using very sensitive microphones and micrometers. Changes in gas pressure are caused by changes in its temperature caused by radiation absorption. The principle of operation of an example photoacoustic sensor is depicted in Figure 4 [13].

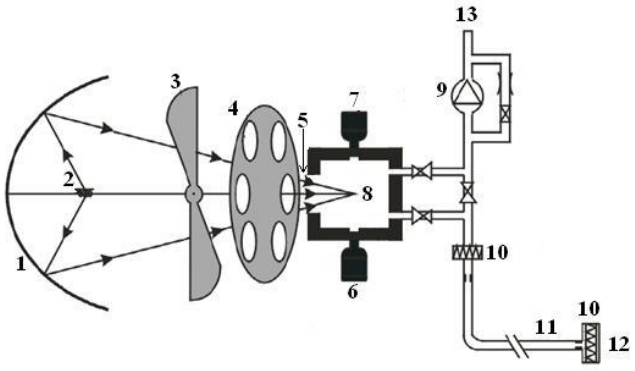

Figure 4. Scheme of a photoacoustic sensor (1: mirror, 2: IR lamp, 3:chopper , 4: optical filters, 5: optical window, 6: microphone 1, 7: microphone 2, 8: measuring chamber, 9: pump, 10: air filters, 11: gas line, 12: air inlet, 13: air outlet).

Source: Z. Bielecki, J. Wojtas, M. Brudnowski, Biuletyn WAT, (2006), Vol. 55, 37-51.

The photoacoustic sensor consists of an IR radiation source, a modulator, a carousel with interference optical filters, a measuring chamber and a gas dosing system. The principle of its operation is as follows: the IR beam is modulated by means of the mechanical modulator dial and is further directed to the filter. Each of the filters transmits radiation of a length suited to the detection of a given chemical compound. In the case of sulfur dioxide detection, a suitable filter must be selected. IR radiation falling on the measuring chamber is absorbed by the gas in it. This absorption is proportional to the concentration of this gas. The absorbed radiation causes cyclic changes in temperature, and thus the pressure of the gas being analyzed. The measuring chamber produces acoustic waves with intensities proportional to the concentration of the gas being tested. Microphones are used to record acoustic waves. The measurements based on the method can be

carried out over a wide concentration range from thousands of ppm to single ppm. Using semiconductor lasers even at ppb level [12].

For the detection of sulfur dioxide in the air, a method based on laser excited fluorescence can also be used. This method belongs to the emission methods. The general idea of this method assumes that excitation of the sample with optical radiation of a specific wavelength can induce a phenomenon of fluorescence. The electrons of the molecule are transferred from the ground state to a higher energy level. The return of the electron to the basic state may be accompanied by the phenomenon of fluorescence. In this way, one can obtain a spectrum characteristic for a given molecule [16].

The scheme showing the principle of operation of the fluorescent method of sulfur dioxide detection is presented in Figure 5 [12].

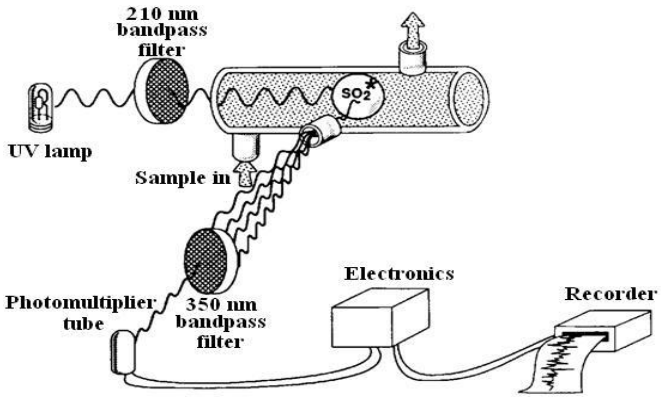

Figure 5. Scheme showing the principle of operation of the fluorescent method of sulfur dioxide detection.

Source: A. Gietka, Z. Mierczyk, M. Muzal, Biuletyn WAT, (2006), Vol. 55, 21-55.

This method requires the use of a coherent radiation source with a precisely defined narrow spectral line. The type of substance can be determined from the emission spectrum. The process taking place in this method can be represented by the following equation:

$$SO_2 + h\upsilon(210nm) \rightarrow SO_2^{\bullet} \rightarrow SO_2 + h\upsilon'(240-410nm) \quad (7)$$

The limit of detection for this method is several ppb. When using this method, knowledge of both the absorption spectrum and the emission spectrum of the test gas is required [12].

Conclusions

The progressing degradation of the natural environment, and especially the deteriorating state of the atmospheric air, has become a stimulus to take steps to counteract these phenomena. Important air pollutants are undoubtedly sulfur compounds. In the atmosphere, they occur primarily as sulfur dioxide and sulfur trioxide. As a result of chemical reactions taking place in the air, they undergo reactions whose final product is sulfuric acid. They cause the occurrence of acid rains, not indifferent to the state of living organisms. Acid rains also accelerate the destruction of objects exposed to their effects.

The action against the progressing atmospheric pollution was the development and implementation of legal regulations under which atmospheric air monitoring was initiated and its protection strategies were developed. Initially at the level of individual countries, with time expanded to the international arena. In Poland, legal regulations are currently harmonized with the law in force in the European Union. Atmospheric air monitoring and the scope of activities are meticulously controlled.

The inclusion of atmospheric air by law contributed to its improvement. Above all, it stopped its use of impunity as a non-exhaustible good. Of course, it is impossible to restore its state from the times preceding such rapid economic development, because it would have to minimize the emission of pollutants into the atmosphere. However, it seems impossible with the constant increase in population. It is possible to track its status and develop technologies that allow reducing the emission of pollutants by anthropogenic sources. Such activity may manifest itself in the trade of emissions of given pollutants. The funds raised in this way may be designed to develop technologies for the reduction of hazardous substances before they are brought into the environment.

The main element of atmospheric air protection is its monitoring. The "in situ" methods and remote sensing methods are used to identify and measure concentrations of gases and chemical compounds in the air. Measuring systems belonging to the second group are more reliable and precise. The most widespread methods of remote detection are undoubtedly LIDAR systems. For the detection of air pollution with sulfur compounds can be used scattering, Raman and differential absorptionLIDAR. However, these are relatively expensive devices. Local topical methods may also be used to determine the concentration. It must be remembered, however, that the measurement will be less accurate. Methods that use sensor analyzers as detector elements are currently developed from the"in situ" methods. Their main advantages are cost, reliability and simple construction.

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THE IMPACT OF ADVERTISMENT ON APPLYING DIETARY SUPPLEMENTS

Magdalena Kolano*, Karolina Dudek

Institute of Nursing and Health Sciences, Medical Faculty, University of Rzeszów

*mkolano20@gmail.com

Abstract:

The aim of the thesis was to show the impact of TV advertising on the use of dietary supplements among people aged 23 years on average. For the purpose of reliable implementation of the task, the frequency of advertising of dietary supplements was checked on three television channels and a survey was conducted among 1000 respondents. These studies show that advertising has a significant impact on the frequency of dietary supplements and that dietary supplements are usually chosen by people watching TV every day.

Keywords:

advertising, dietary supplements, students, vitamins

Introduction

The market of dietary supplements in Poland is developing at a very effective rate. According to a report by the National Chamber of Control in 2015, the Polish allocated PLN 3.5 billion to dietary supplements, converting 190 million packages for the purchase. Per person, the average Pole bought 6 packages of dietary supplements, spending about PLN 100 on them. In the register of the Main Sanitary Inspectorate since 2007, nearly 30,000 products have been entered and reported as food supplements. Current observations show that this market will evolve around 8% annually in 2017-2020 [1].

More and more often healthy people which use a balanced and varied diet, reach for additional nutrients in the form of dietary supplements. Many current and older research show, that dietary supplements are very popular among various age groups, regardless of diet [2,3]. Obvious is the fact that advertising often determines the choices made by the recipients, influences the shaping of their values and views [4,5]. Despite the growing importance of the Internet in marketing activities, television is still the most used means of communication, which seems to be created to satisfy the viewer's desires. Every year, 40,000 advertisements reach new audiences, which are constructed in a specific way, show the advantages of the product and model the actions of consumers, especially the youngest ones. The respondents prefer advertising spots that are targeted at their age group. [6].

Aim

The aim of this thesis was to determine the impact of TV advertising on the use of dietary supplements, their prevalence depending on sex, BMI, diseases, season and measure the quantity of supplements ads on selected TV channels (TVP1, Polsat, TVN).

Material and Methods

The research was conducted in a group of 1000 people, including 748 women and 252 men. It included determination of preferences and dietary supplement selection factors among respondents, whose average age was 23 years (average age of men 23.4 +/- 4.7, average age of women 23.2 +/- 4, 5). An online questionnaire of one's own authorship was used, which included questions related to sex, age, BMI, accompanying disorders, TV viewing frequency and many factors affecting the use of dietary supplements. The results were developed by means of the Statistica 10.0 program. Statistical significance of differences was estimated at $p < 0.05$.

In addition, the method of direct observation and the current recording, which last continuously 12 hours (9:00 - 21:00) on 26/04/2018 on three TV channels (TVP1, Polsat, TVN), the number of advertisements for dietary supplements was determined: slimming, digestion, sedative, concentration-promoting, hair, skin, nails, several minerals and other supplements.

Results

In the observation of TV channels, the most of dietary supplements ads within one hour (17) was displayed on the TVP1 channel between 13:00 and 14:00. However between 14:00 and 18:00 the number of advertisements for dietary supplements on the TVP1 and TVN channels was even (nearly 26 ads), while at the same time at the Polsat station there were only 10.

On all three TV channels, the frequency of advertising for dietary supplements was close to zero between 19:00 and 21:00. Between 20:00 and 21:00 only 6 advertisements of supplements appeared on TVN station, while on the other there was no advertisement.

Of all channels, the most advertisements for dietary supplements were broadcast on TVP1 (56 within 12 hours), which gives about 5 ads of dietary supplements per hour. The next station was TVN, while Polsat is practically half as many (26 within 12 hours).

The most advertisements of dietary supplements include preparations: supporting digestion, varicose veins and strengthening the condition of the body.

Table 1 presents the variety and quantity of dietary supplements advertised on the television stations described.

Table 1. Quantity and variety of dietary supplements advertised on 3 television stations

Preparation	TVP1	Polsat	TVN	SUMMARY
Supporting digestion	16	9	3	28
For urinary infections	6	2	14	22
Supporting slimming	1	2	4	7
Strengthening the condition of the body	15	2	9	26
Reassuring	0	0	2	2
Supporting vision	0	2	1	3
Supporting the condition of skin, hair and nails	1	2	9	12
For varices	14	6	7	27
For allergy	3	1	1	5
Summary	**56**	**26**	**50**	**132**

Source: Calculations of one's own authorship

The questionnaire survey shows that 47% of respondents eat dietary supplements, more than half (52%) of these respondents declare their daily use. Most often, respondents reach for dietary supplements in the spring and summer.

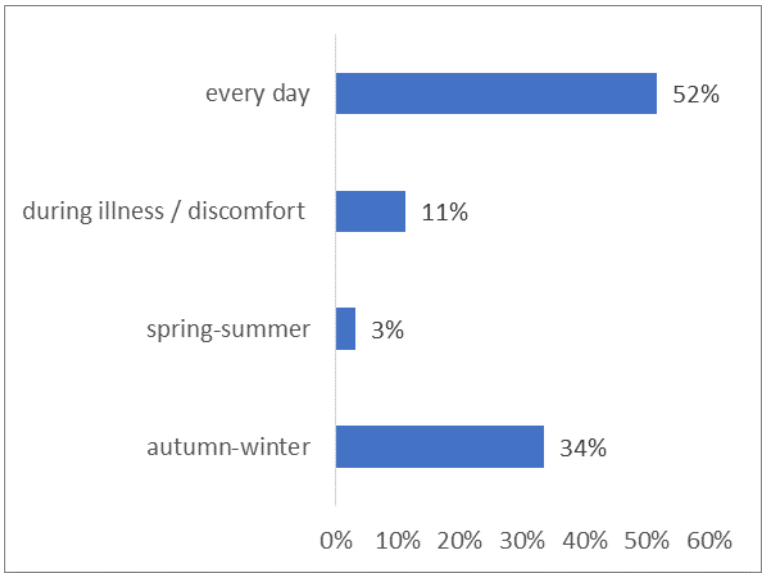

Fig. 1. The frequency of taking dietary supplements (%).
Source: Calculations of one's own authorship

The most common reason for using dietary supplements by the respondents was to supplement the deficiencies of vitamins or minerals (68%). Women declared (142) in 30% that they use food

supplements to improve the condition of hair, skin and nails, while men (14) only in 3% declare taking these supplements. Female sex most often reaches for minerals (61.1%), vit. D3 (39.3%). Male sex is dominated by the intake of minerals (magnesium, calcium, iron) (17.4%), supplements for athletes (17%) and strengthening immunity (13,6%)

Tab. 2. The most common using groups of dietary supplements (%).

Supplement	Woman	Man
preparations strengthening hair, skin and nails	30%	3%
for athletes	10,80%	17,00%
Minerals (magnesium, calcium, iton)	61,10%	17,40%
for improving concentration	6,40%	2,90%
strengthening immunity (eg vitamin C)	33,50%	13,60%
strengthening the body (eg ginseng, ashwagandha)	18,30%	8,50%
vitamin D3	39,30%	13,40%
folic acid	11,30%	1%
supporting digestion	6,60%	4,70%
Sedative	5,90%	2,30%

Source: Calculations of one's own authorship

The information contained in the questionnaires shows that overweight / obesity people more often reach for dietary supplements in order to reduce their weight, while respondents with normal body mass more often take supplements to complete deficiencies of vitamins or minerals ($p = 0.02$). In this case, statistical significance was demonstrated.

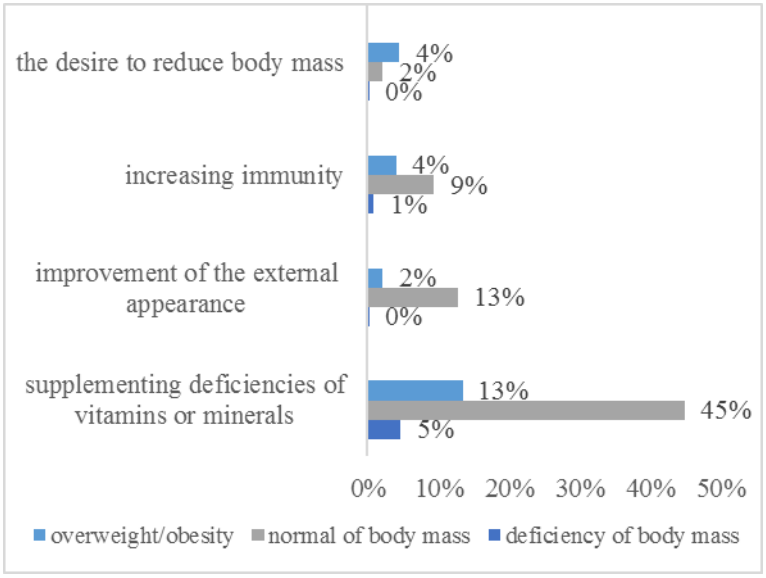

Fig.2. The goal of taking dietary supplements
Source: Calculations of one's own authorship

When respondents were asked what they are governed by during choosing the preparation, vast majority answered that the composition of the preparation is the most important (70% of respondents). Another important aspect was the price (14%).

In this survey, it was checked whether the respondents consult the choice of applied dietary supplements with a doctor. It turns out that only 30% of the respondents took this action.

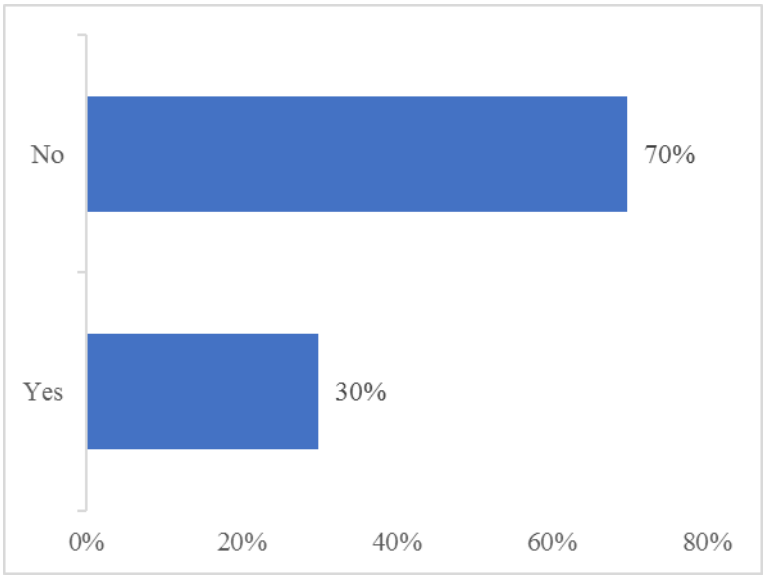

Fig. 3. The consultation of decision about using dietary supplements with a doctor
Source: Calculations of one's own authorship

The analysis also shows, that respondents most often reach for dietary supplements every day, what's more, as many as 42% of people use more than 4 preparations on a daily basis.

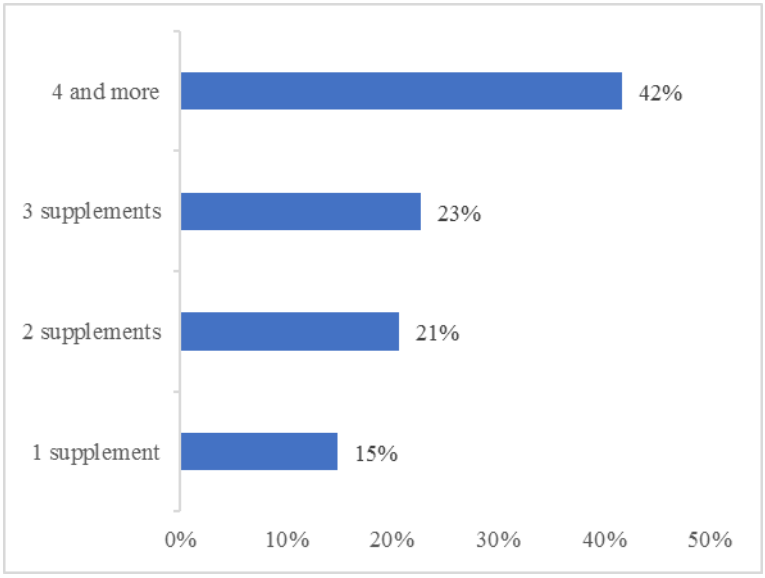

Fig. 4. The amount of supplements consumed every day
Source: Calculations of one's own authorship

While creating the survey form, it was hypothesized that television has the greatest impact on the use of dietary supplements. It turns out that respondents who mostly use diet supplements declare that they do not watch TV.

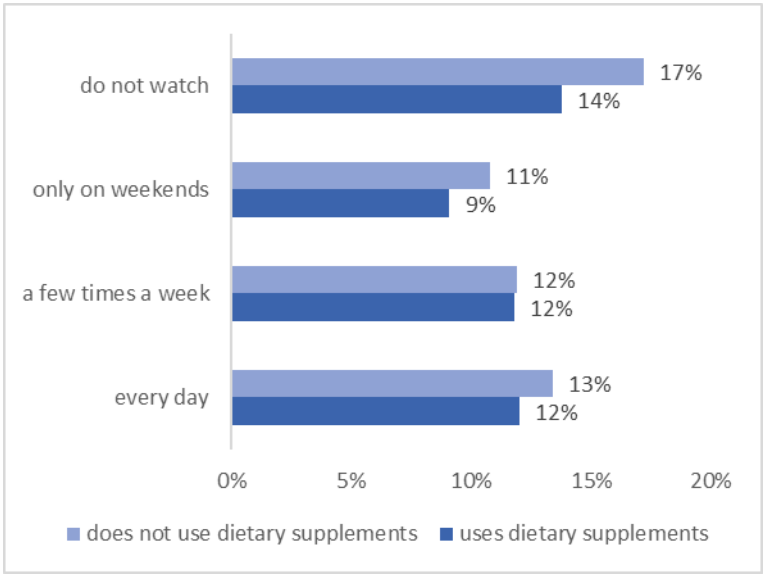

Fig. 5. The use of supplements and the frequency of watching TV
Source: Calculations of one's own authorship

However, the analysis of the advertisements shows, that respondents choose these dietary supplements (preparations strengthening hair, skin, nails), which are mostly advertised on TV. Therefore, the advertisement affects the type of selected dietary supplements.

Discussion

The questionnaire survey shows that 47% of respondents eat dietary supplements, more than half (52%) of these respondents declare their daily use. The respondents rarely reach for dietary supplements in spring and summer.

In a survey conducted by Ranellii et al. [7], in a group of 692 pharmacy students, also 47% of people admitted that they used dietary supplements. In turn, research conducted by Lebedzinska et al. emphasize the widespread use of dietary supplements by students. According to them, daily supplementation was declared by 25.8% to 9.0% of respondents [8].

The most common reason for using dietary supplements by the respondents was to supplement the deficiencies of vitamins or minerals (68%). Women declared (142) in 30% that they use food supplements to improve the condition of hair, skin and nails, while men (14) only in 3% declare taking these supplements. Female sex most often reaches for vitamin preparations (61.1%), vit. D3 (39.3%). Male sex is dominated by the intake of supplements for athletes (8.7%), strengthening the body (13.6%) and magnesium (10.9%). Spiołek and co-workers [9] in studies conducted among students of the Medical University of Silesia, they found that 70 - 75% of the surveyed students also used vitamin and mineral preparations to improve the appearance of the skin, hair, nails, and 44.5% prophylactically or in convalescence after illness.

The results of the surveys analyzed differ from the results of the TNS OBOP study, which show that only during the cold, influenza the vast majority of Poles (91%) use supplements, drugs and, above all, brands known from television commercials [5].

When asked what the subjects are when choosing the preparation, the vast majority answered that the composition of the preparation is the most important (70% of respondents). Another important aspect was the price (14%). In a survey conducted among pharmacy customers by Ulatowska-Szostak [3] in 2002 and in 2007, only 1/3 of the respondents declared that they were looking for information about the advertised vitamin preparation being consulted with a pharmacist or even the leaflet included with the preparation. The rest of the people were guided solely by advertising. The research carried out in the group of post-secondary school students (aged 19-45) in Zabrze showed that consumers choosing the vitamin-mineral preparations were mainly guided by the composition of the preparation (67%) and then the price (50%). Only 18% chose advertising as the main motive for the purchase of vitamins and minerals [10]. Among respondents, only 39.3% of women and 13.4% of men supplement vitamin D3, what's more, its advertisement appeared during the day only 2 times on one of the observed TV channels.

In this thesis, it was checked whether the respondents consult the choice of used dietary supplements with a doctor. It turns out that only 30% of the respondents took this action. A similar study, testing the impact of advertising on the health choices of Poles, was conducted by Kubiak and Kuleszka [11], where it was shown that 58% of respondents find out about painkillers from TV advertising, and 28% directly from the doctor. However, according to the Schlegel - Zawadzka and Barteczko [12] studies, 39.8% of respondents learned about supplements from conversations with people unrelated to medical science, and 36.9% from television commercials.

In Szpringer et al., It was shown that the choice of drugs and dietary supplements is often driven by advertising (1/4 of respondents), although they are aware that the information contained in advertising messages is not always reliable [13].

Conclusions

The presented research shows that:

1. Most advertisements of dietary supplements include preparations: supporting digestion, varicose veins, strengthening the condition of the body.

2. The most common reason for using dietary supplements by the respondents was to supplement the deficiencies of vitamins or minerals and at the same time these were the supplements most often found in television commercials. For women, the main aspect was supplementation to improve the condition of hair, skin and nails.

3. The supplementation of vitamin D3 is declared by 1/3 of respondents, what is more, its advertisement appeared during the day only 2 times on one of the watched TV channels.

4. When watching TV commercials, it is worth remembering not to be fooled and remember about healthy lifestyle, rational eating habits, physical activity, which healthier but cheaper than buying supplements provide us with well-being and health.

Side effects

There were minor side effects during the continuous 12-hour follow-up of dietary supplement ads. In the evening hours (17:00 - 18:00), back pain, irritability and headache appeared. At the end of the observations, the research group showed more and more nervousness and waiting for the end of the day spent in front of the TV.

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FIVE STEPS TO INNOVATIONS. THE IDEA AND APPLICATION OF DESIGN THINKING METHODOLOGY

Katarzyna Mordal

Student Science Association Design Thinking Space, Institute of Mechanical Technologies, Faculty of Mechanical Engineering and Computer Science, Czestochowa University of Technology, Częstochowa

kmordal@iop.pcz.pl, katarzyna.199212@gmail.com

Abstract:

The publication refers to Design Thinking methodology, as a result of which innovative, sometimes original solutions – new products or services – are created. In this paper, the notion of this method has been presented and five phases of Design Thinking: empathizing, defining the problem, generating ideas, prototyping and testing solutions, which form the whole structured design process, have been discussed. The examples of application of Design Thinking methodology both in everyday life and in the business have been also presented.

Keywords:

Design Thinking, innovations, service and product design, creativity

Introduction

Recently, Design Thinking has been increasingly mentioned and written. This methodology – first and foremost – makes for solving various types of complex problems, encountered by companies, entrepreneurs or other types of institutions and organizations during running their business. Secondly – it supports the development and design of innovative, sometimes original products or services, and the improvement of existing ones. Thirdly, it stimulates creativity in making these solutions [1-2].

Let's start from the beginning – genesis of Design Thinking

The beginnings of Design Thinking go back to the 1960s, when the first publications about creativity and design products in various areas of life were recorded and the first use of this term was noted. However, the real and rapid development of this methodology took place in the 1980s and 1990s, when first ventures compatible with the concept of Design Thinking were created at Stanford University in California (Fig. 1 a). Then, with the increasing demand of entrepreneurs from Silicon Valley, this method was treated as a tool facilitating the transfer of creative ideas, visions or other imaginative solutions from the world of science to the world of business [2-8].

One of the forefathers and main creators of Design Thinking was David M. Kelley – Professor at Stanford University (Fig. 1 b), who together with other scientists founded design office – IDEO (Fig. 1 c) using DT methodology in commercial applications. Currently, this company has many

design offices around the world and excels in its field, as shown by the fact of cooperation with such brands as e.g.: Apple, GE, Microsoft, Toyota, Ikea, for which it has developed solutions of new products and services. In 2004 the Institute of Design at Stanford University, commonly named as *d.school* was also established on the initiative of David Kelley. Similar school – HPI School of Design Thinking was set up in 2007 in Potsdam (Germany). These two design centers are aimed at the development and popularization of DT method among students and allow them to carry projects out (in accordance with the spirit of Design Thinking), which are directed to different business entities or local communities [2-4, 6-7, 9-12].

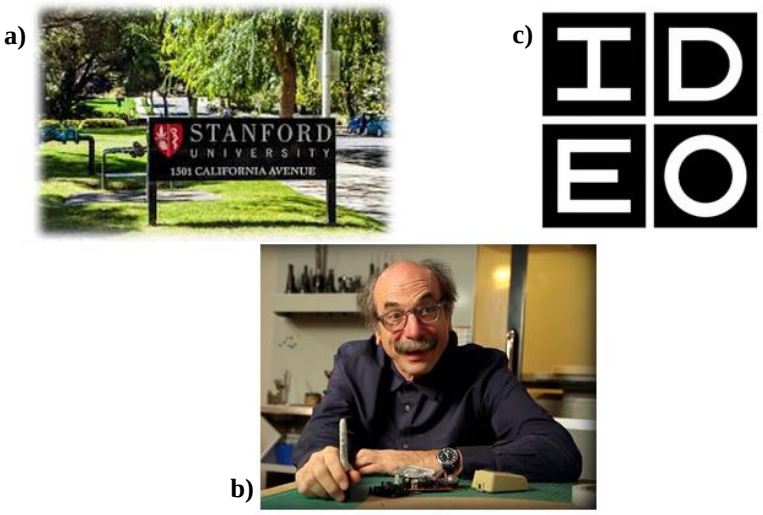

Figure 1. From Stanford University (a) to IDEO (c) – the career of Prof. David Kelley (b)

Source: own study based on: [5, 13-14]

Basic assumptions and rules of Design Thinking

Design Thinking methodology owes its effectiveness in the design of new and innovative products and services to design process based on detailed understanding of receivers, i.e. their problems and needs. In this way, solutions, which are desired by customers due to the fact that they meet their needs, are created. In addition, they evoke positive emotions, which has a beneficial effect on the perception of the product. However, in order for this positive vision to be taken place, it is necessary to apply a few essential elements, which are the basis for the process compliant with Design Thinking [2, 4, 6, 10-11].

Firstly, this is ***concentration, focus on the other person, user, future client*** (Fig. 2 a), according to the slogan: *„the most important is User – not me!!!"*, which allows to understand both the conscious, and unconscious needs of customers and their problems, giving great possibilities during generating ideas. Hence, the potential solutions should not be looked through your own eyes, but user's, that is from his perspective, going beyond some familiar frames (i.e. to be *out of the box*) – experience and habits, which block people's creativity [2, 6-7, 10-12, 15-17].

Secondly – this is ***interdisciplinarity*** (Fig. 2 b), connected with the work in teams consisting of people representing various fields or branches of science. A broader overview of a given problem or a need, view from many different perspectives is obtained due to this element. Additionally, work in interdisciplinary teams stimulates the creativity and exchange of experience, which –

in turn – drives effectiveness of their members and leads to generation of innovative, occasionally unconventional, abstract solutions [2, 6-7, 10-12, 15-17].

The third essential element is ***experimentation and hypotheses testing*** (Fig. 2 c), which allows to get unconventional solutions and to check them (i.e. it helps to answer the questions such as: *will a given product or service meet the user's needs?, will it solve his problem?*). An additional advantage of testing is getting a very important feedback from potential users, who are valuable source of information about the given solution. They will say what is bad, unnecessary, what should be changed, improved or what should be left behind. Such testing, in turn, allows to constantly modify prototypes and check, whether the given solution brings the desired, expected effect [2, 6-7, 10-12, 15-17].

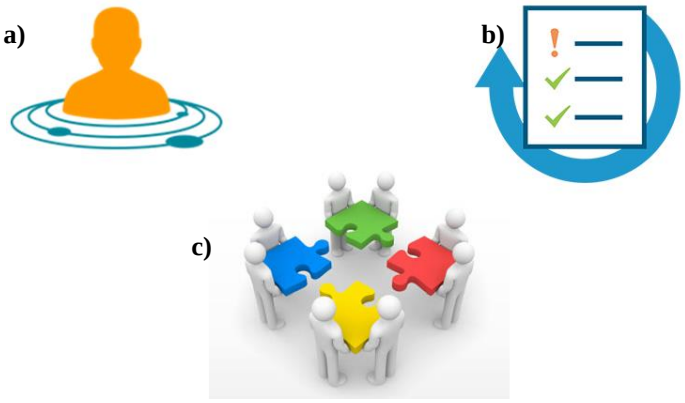

Figure 2. The symbolic presentation of basic assumptions of Design Thinking: focus on the other person (a), interdisciplinarity and teamwork (b) and experimentation and hypotheses testing (c)

Source: own study based on: [18-20]

At the same time, the design process, should be also based on a few principles, named as Design Thinking rules, which are [2, 6-7, 9-12, 17]:

- ***human rule*** – according to which design has a social nature, hence the main purpose of created solutions is to satisfy human needs or to solve existing problems, faced up by users in everyday life;
- ***the rule of ambiguity*** – according to which experimentation, looking at problems from different perspectives and going beyond limits or learned schemes and patterns have positive influence on creativity and innovation;
- ***the rule of tangibility*** – according to which an idea should be visualized, made tangible, e.g. through simple prototypes, which facilitates communication, gives the opportunity to check whether a given solution meets the conditions and functions set at the very beginning and allows to gather feedback from users;
- ***the rule of putting emotions*** – because nowadays, success is achieved primarily by those products and services, which not only speak functionally, but also evoke positive emotions in people.

Basing the design process on the above-mentioned assumptions and rules allows to generate solutions, which are firstly desired by potential customers, secondly – technically possible and thirdly – their implementation is economically cost-effective for the company [2, 7].

Let's back to the essence – what is Design Thinking?

Design Thinking is a process primarily aimed at creating new, innovative products or services, or solutions that can be the basis for improving existing ones. However, it should be noted, that the new products and services are not the result of copying those already available, but are new, original, sometimes abstract solutions, which are based on deeply recognized needs and problems of recipients [2, 6, 8-9].

In the available literature about Design Thinking methodology, there is no single, clear definition of this term. Tim Brown, the current CEO of IDEO said that *„Design thinking is a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success."* whereas according to IDEO ideology *„Design thinking is a process for creative problem solving"*. In turn, Thomas Lockwood, author of among others *„Design Thinking: Integrating Innovation, Customer Experience, and Brand Value"* pointed to the fact that Design Thinking is a process focused on human and his needs, saying: *„Design thinking can be described as a discipline that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity"*. In summary of the available definitions of Design Thinking, it can be stated that this is a structured approach to solving various problems, an intellectual framework for innovation and customized solutions, as well as an intuitive method of work, or rather close cooperation, as a result of which the innovative products and services are created or are being improved. DT is also a set of specific tools and different working methods (mainly in the form of workshop teamwork) used in business [5, 7, 9, 12, 21-22].

Five steps to innovation – the stages of Design Thinking

Design Thinking is a structured approach to generating and development new solutions. It is based on five stages that help to carry out the project development from identifying the problem to searching for and thinking out solutions. The phases of empathizing, defining the problem, generating ideas, prototyping and testing solutions, presented in Fig. 3, arranged in specific sequence, form an iterative process that allows all of the time to improve the final result [2, 4-12, 15-17, 23-26].

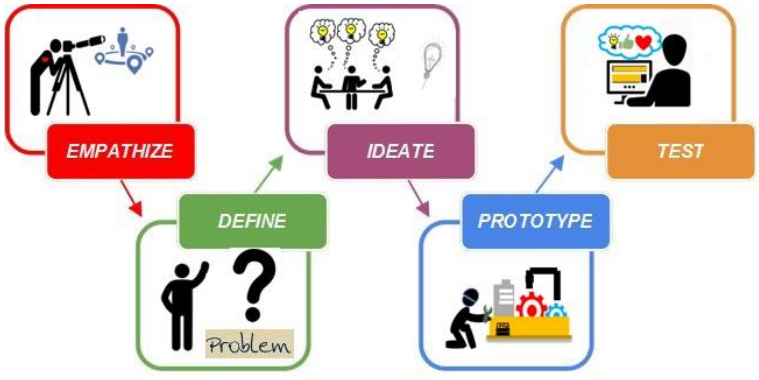

Figure 3. The stages of Design Thinking

Source: own study based on: [2, 5, 7]

It should be noted that only the transition from the first, through all subsequent to the last stage gives the opportunity to achieve the required effect. The omission of one of the phases or changing the order can lead to start the process from the beginning, which is associated with a waste of time and increased costs [2, 4-12, 15-17, 23-26].

In user's shoes – the stage of empathize

The first stage of empathize, also called the cognitive, observational stage, is based on the so-called entering the user's skin, shoes and looking at a given problem from the point of view of that person, which is related to the fact that each person has his own habits, which affect the solutions. Here, the most important assumption is to move focus on the recipient, group of people, i.e. a potential client, hence it is necessary to understand his needs, problems and to recognize unconscious ones – implicit premises, intuitive motivations that determine human choices. Market or technological conditionings of project should be also understood [2, 4-12, 15-17, 23-26]

During the implementation of the stage of empathize, various tools are used, e.g. interviews, surveys or questionnaires, thanks to which it is possible to get to know the other person, get and deduce a lot of interesting information about the recipient. Lurking the behaviour of potential clients is also used. So-called empathy maps, supporting the analysis of observations and favourable for unexpected insights and conclusions are popular too. This tool helps to answer the questions: *what does the client think and feel?, what does he hear?, what does he see?, what does he say and do?* It aids, in turn, a deeper analysis of: customer's thoughts, dreams, fears, connected with a given problem or need, which with opinions of other, familiar people about this problem, his surrounding or attitudes, behaviour in different circumstances gives the full spectrum of subject. In phase of empathize, only the method, based on *focus group*, does not work, because people tend to average their responses against the background of the other survey participants, which, in turn, lead to the avoiding of negative opinions and to the drawing false conclusions [4-12, 15-17, 23-26].

Empathize stage should be ended with the collecting of data, both qualitative (detailed) and quantitative ones, but their amount is directly dependent on the scope of research, scale and complexity of problem. The provided research material should be so comprehensive in order to build real situation problem in the next steps. It is connected with the overcoming of existing pattern thoughts, stereotypes and prejudices, which can *muddy the issue* [2, 4-12, 15-17, 23-26].

What's the problem? – defining the problem

The next step, i.e. the diagnosis of needs and defining the problem, is analytical stage, based on the synthesis and analysis of obtained earlier (during empathize phase) information, in order to accurately diagnose right problem and answer the questions: *what are the user's needs? what is important for him? how can other help him?* This stage is the biggest challenge, because for many project groups it is difficult to define the problem or need of potential customer. This phase requires a broad view on the given issue, turndown of standard thought frames (habits, learned schemes), a large amount of time and very precise analysis of received information, which allow to determine the actual problem and facilitate further design stages. A mistake at the stage of diagnosis, in turn, results in, most commonly in practice, failure and leads to repeat the whole process from the beginning [2, 4-12, 15-17, 23-26].

During the implementation of the second Design Thinking stage a tool called 5×*why* is used. It is an iterative technique aimed at analysis of casual connections of a given problem and determination its source, initial reason, which should be detected (thanks to the next questions: *why?*) and eliminated. Sometimes, the other methods are applied, i.e. *re-framing the problem*, allowing to change the perception of the issue, and *mapping problem: how? vs. what for?*, which helps in understanding the differences between this questions [2, 4-12, 15-17, 23-26].

1, 2, 3, 4, i.e. generating ideas

The stage of generating ideas, also known as the ideation stage, is one of the most creative in the whole design process. During its implementation it is necessary to generate as many ideas as possible, which gives a large spectrum of potential solutions, according to the slogan: *„the most important is the number of ideas, not their quality"*. In this case it is essential to cast out all limitations, related to the lack of acceptance of one's own idea (solution) against the background of the group, because not only the reliable substantial background plays a key role, but above all, the openness, courage in creating interesting solutions and willingness to cooperate in a team. In addition, it is memorable that the most abstract and crazy, ideas are also remarkable, noteworthy. Out-of-the-box solutions are often a big advantage, because they can inspire other team members to the further ideas too. During implementation of generation stage, the ideas are not judged, criticized or rejected by the other team members, for it kills creativity. It is also important to remember that this stage should take place in a pleasant atmosphere and setting, which stimulates invention and openness in generating idea. This stage ends, when out of all will be chosen (often, in a democratic way, by voting) the best idea, on basis on which the prototype will be created [4-12, 15-17, 23-28]

One of the basic tools applied in this stage is *brainstorming*, in which coloured sticky-notes, post-its are used. Each idea is saved on them. Then post-its are pinned to a wall, blackboard or flipchart in various configurations, but sometimes they are attached in another place, deleted or changed to other, which reminds that this process requires a lot of flexibility and distance to one's own ideas. In addition, there are used other techniques, i.e. *mind-mapping*, *brainwriting*, *analogies*, *the pyramid of associations* or *Six Thinking Hats method*, each of which is only a starting point to determine further directions of action [2, 4-12, 15-17, 23-28].

Let's make it – prototyping

The fourth stage of Design Thinking, i.e. prototyping, is a key phase of the process, because it reduces the risk of failure. Its purpose is not to create complex prototype accurately reflecting the final product, but to sketch the model that visually demonstrate the future nature and functions of the finishing solution. However, the more is detailed, the better for testers, who in the next phase will not draw conclusions based on guesswork, but only on observed facts. Obtained opinions about developed solution already at the preliminary stage allows to find out, if the team's vision is consistent with the vision of the potential recipient, or however, completely deviate from it – then there is still time to modify the direction of further work. It will save not only time and money, but it helps to bring the product closer to the market success [2, 4-12, 15-17, 23-26].

The prototypes are built from the various, simplifiest materials with using of simply tools, e.g.: paper, cardboard, foam, plastic, polystyrene foam, wood, plasticine, glues, scissors and other available resources or existing products, which can be cut, glued, painted, stapled etc. Prototyping

with using 3D or computer simulations also becomes more and more popular. As a result of these moves, prototypes of innovative products are usually obtained, but this is not always a subject. In the case of services or mobile and web applications, there are applied comics, storyboards, storytellings, layouts, user's path drawings, stagings or other than a verbal description of ways to visualize ideas [2, 4-12, 15-17, 23-26].

Test it and start all over – testing solutions

The last stage of Design Thinking is testing the generated solutions, whereby it should be noted that their improvement and evaluation during this phase is a continuous process. This stage is based on presenting a prototype to customer, user in real environment in order to obtain an opinion about it. It allows to get unbiased assessment and feedback, thanks to which it is possible to modify the prototype and ultimately get the desired effect. Then, after a positive evaluation, being the result of tests, the given solution is ready for implementation [2, 4-12, 15-17, 23-26].

In addition, it should be noted that testing is a quite sensitive phase, because a lot of company secrets can go out before the official launch of the product. Thereby, regardless of the nature of testers, it is necessary to provide appropriate legal safeguards, based on signing confidentiality and non-competition agreements by testers before any their contact with the tested solution. These people, who will not be able to sign the above-mentioned documents, are definitely disqualified from the research [2, 4-12, 15-17, 23-26].

The testing stage is very often skipped, which is very disadvantageous for the whole process. It increases the risk of committing errors, e.g. solution mismatch to the needs of a given group of recipients, which, in turn, causes a waste of time, money and energy [2, 4-12, 15-17, 23-26].

The application of Design Thinking

Design Thinking methodology is multidisciplinary and cooperative, i.e. assumes cooperation between specialists working in various areas of life, which aids multipronged, comprehensive looking at a given problem, from different perspectives. In addition, it is human-centred, based on empathy and needs and motivations of potential customer. Furthermore, it has an aspect of experimentation, optimism and divergence, because it assumes that there is not one concrete problem solution – there are many possibilities, which results from the various views on the given problem [8].

The above features make Design Thinking methodology work perfectly in all organizations, looking for solutions to complex problems or these ones which aim at designing the future, i.e. innovative products and services, hence it is used by various types of companies, schools, universities, NGOs, associations and other institutions. DT methodology is a way to develop innovation in small steps, thanks to which new products, packagings, services, public space projects, marketing concepts or disruptive technologies are created, therefore it can be applied both in industry, business, education, socioeconomic fields and in everyday life [2, 7-8].

For example, IDEO project company cooperate in development solutions for new services and products with such brands as: Apple, BASF, GE, HP, Microsoft, Toyota, Pepsi- Cola, Ford, Bayer, Samsung, but also with governmental, public and non-profit organizations, universities or hospitals. Numerous successes on the market, caused by the use of DT, made other big companies also wanted to apply it, as example of which is Procter & Gamble company. However,

Design Thinking is not exclusively reserved for giants, great players. Oppositely, it is also fitted for small organizations, companies, start-ups, all ones, who want to solve unusual problem, put innovative products or services on the market or improve existing ones. As a example project implemented in accordance with Design Thinking methodology is the first laptop or computer mouse (Fig. 4 a), which Steve Jobs worked at under the supervision of David Kelley. Also, articles of daily use, e.g. Oral-B - electric toothbrush (by Braun company), were created thanks to this method. Another example of a DT-based solution is *„The NeoNurture"* project (Fig. 4 c), i.e. an incubator designed to save the lives of African newborns, which was built from car parts – Toyota components – the most popular car in Africa. In turn, at d.school at Stanford University, students designed the Pulse application (Fig. 4 b), which was sold to LinkedIn company for tens of millions dollars. The above-mentioned examples show, that Design Thinking can be used in various areas of life, contributing to creation of new solutions, which are necessary people and meeting their needs [2, 4-11, 16-17, 23-24, 28].

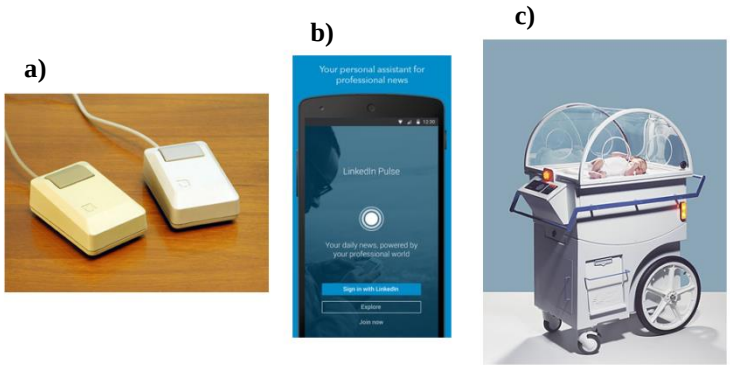

Figure 4. Examples of using of Design Thinking: a computer mouse (a), Pulse application (b) and the NeoNurture project (c)

Source: own study based on: [29-32]

Summary

Design Thinking is a tool leading to creating solutions, which comply with the needs and expectations of target users of products and services, i.e. potential customers. DT methodology rises in people – users, customers, employees, residents and ends with innovative solutions tailored to their needs. In short, this process is based on building deep empathy and understanding people for whom the project is being carried out, on generating ideas, creating simple solutions and testing them in practice. Therefore, Design Thinking methodology combines analytical competence with intuition and focusing on potential users, it makes for the creation of dedicated, useful solution in every realm – local government, business, social or scientific [7-10, 12, 25].

In summary, Design Thinking is based on five very important stages: empathy, defining the problem, ideating, prototyping and testing the generated solutions. Focus on the other person, a precise diagnosis of the problem, to which the solution is designed, but also workmanlike brainstorming and not limiting one's creativity – all this go to make complete and efficient process, designed to meet the specific needs of testers. The result is innovative product or service, which can achieve significant success on the market [7-10, 12, 25].

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GREEN DEMULSIFIERS IN CRUDE OIL EMULSIONS TREATMENT

Piotr Pacholski

Department of Chemical Engineering, Faculty of Process Engineering and Environmental Protection, Lodz University of Technology

piotr.pacholski@edu.p.lodz.pl

Abstract:

The aim of this paper is to present topic of chemical treating of petroleum emulsions in order to separate water phase from this systems. The existence of water in form of emulsion with crude oil is undesirable since it may lead to corrosion of transport equipment and it also generate bigger cost associated with transporting water mixed with petroleum. Usually, to treat crude oil emulsions the special kind of chemicals known as demulsifiers are used. Often this chemicals are eco-unfriendly and toxic. Current research are focused on development of new greener demulsifiers. In this review we present the issue of the chemical demulsification, demulsifiers role and progress in formulation of new "greener" emulsion breaking chemicals.

Keywords:

emulsified crude oil, emulsion breaking, stability

Introduction

Usually emulsions are formulated to maintain stable for long time. Examples can be found in food or cosmetic industry. However in petroleum engineering emulsion is undesirable, therefore the chemists and engineers look for optimal solutions to break crude oil emulsions formed in the process of oil extraction [1]

All types of emulsions consist of two immiscible liquids, where one is called internal phase, while another is called continuous phase. These two phases are stabilized by a chemical called emulsifying agent or emulsifier. There exist two basic types of emulsions: water-in-oil (W/O) and oil-in water (O/W). In petroleum industry the most common are water-in-oil (W/O) emulsions, where the water is dispersed, and oil is continuous phase. [2]. Fig. 1 shows the water-in-oil crude oil emulsion before and after phase separation as well as its microscopic picture. [3]

The process of emulsion creation is called emulsification. In case of crude oil, emulsification takes place due to existence of natural surfactants in oil structure such as asphaltenes and resins [4]. Stable emulsions are generated during crude oil mining, because water and oil coexist in the reservoir and the enhanced contact during pumping out is unavoidable [5]. Emulsification phenomenon was a subject of many research and was reviewed many times in literature. Especially in paper regarding the crude oil emulsions formation, the authors [6]; [7]; [8] investigated the

emulsion formation mechanisms. Basically there are three criteria's, that need to be fulfilled for emulsions to form [9]:

- There must be a contact of two immiscible liquids
- The emulsifying agent must be present (such as asphaltenes and resins)
- There must be sufficient mixing energy present to disperse one liquid into another

Especially during Enhanced Oil Recovery Operations (EOR) water can be intentionally added to improve extraction efficiency, and therefore massive amounts of crude oil emulsions are generated that needs special chemical treatment [10].

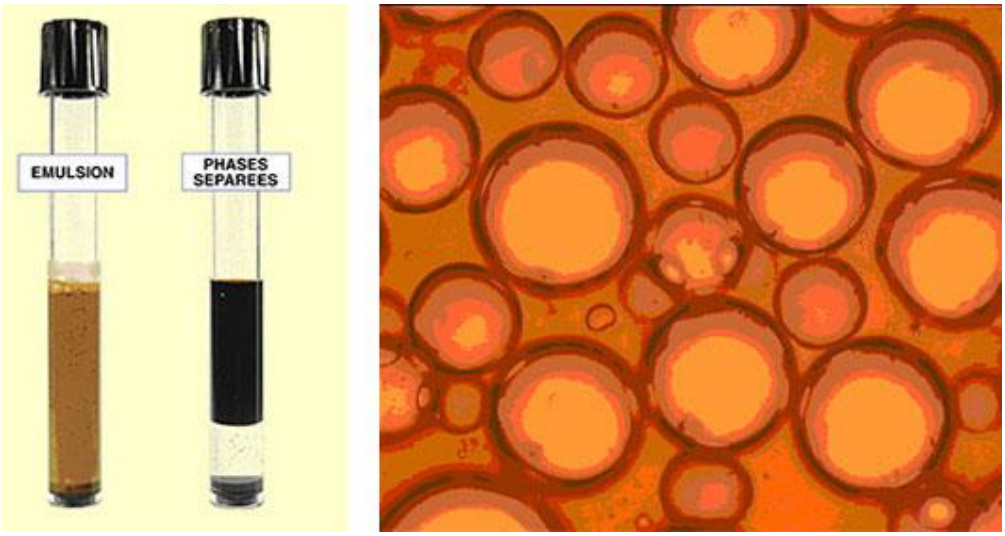

Figure 1. Crude oil emulsion: water-in-oil type (W/O)

Source: [3]

The existence of water in crude oil leads to number of problems in its production, transportation and processing. This problems may include [1]:

- Reduction in efficiency of the vessels, since oil is extracted with water
- Corrosion of equipment that include plant parts and pipelines, since salts are dissolved in the water phase
- Environmental concerns due to unacceptable oil content in effluent water
- Decreasing API gravity, resulting in higher density and lower price for barrel

Therefore to break emulsions efficient techniques are needed. There exist a need of developing inexpensive, effective and ecological friendly technology to deal with this systems. The objective of this review is to present findings in area of crude oil demulsification that includes presentation of emulsion destabilisation phenomena. In this paper we focus chemical emulsion breaking and a role of demulsifier.

Petroleum emulsions demulsification with usage of demulsifiers

There exist a number of methods of breaking crude oil emulsions, and each method have advantages and disadvantages. Available methods can be categorized in to following groups :

- Mechanical
- Thermal
- Electrical
- Chemical

Among the mentioned, chemical method is the most crucial and common choice. In this technique massive amount of chemicals are used to separate water from the crude oils. The drawback of chemical demulsification is that designed chemicals are expensive and usually toxic and eco-unfriendly [11].It needs to be mentioned that demulsification with the usage of chemicals is a very complex phenomenon and the performance of demulsifiers can be affected by crude oil composition and emulsion parameters such as salinity or solid content [12].

The chemical compounds used for emulsion destabilization are called demulsifiers, and their objective is to enhance separation of the water and oil phase. Water-in-oil (W/O) emulsions demulsifiers act by preferentially adsorbing at the interface of the water droplets with the oil and displacing natural emulsifiers. This leads to weakening of the film around the droplets and cause coalescence and phase segregation [13].

The explanation why emulsifier for one emulsion can act as a demulsifier for other lies in the hydrophile-lipophile balance (HLB) of the surfactant. HLB number expresses the relative simultaneous attraction of surface active agent for two phases of the emulsions. HLB scale varies from 0 to 20. High HLB- that means over number of 10 means that the emulsifier is predominant of the water loving group, and will have stronger attraction for the water phase (hydrophilic) and therefore it will create O/W emulsion. Contrary, the emulsifier with low HLB - below 10, have stronger attraction for the oil phase and results in formation of W/O emulsion. The HLB of 10 means that oil and water loving groups are balanced [14]. The mentioned explanation means that emulsifiers that will stabilize O/W emulsions are likely to act as demulsifiers for W/O emulsions and vice versa. It means that for water-in-crude oil emulsions (W/O) that are stabilized by low HLB surfactants, the demulsifiers with high HLB needs to be added.

Emulsifiers and demulsifiers can be categorized into the following groups, that are connected with their chemical structure [15]:

- Anioninc
- Cationic
- Zwitterionic
- Non-ionic

The good demulsifier needs also to meet few expectations [13]:

- It needs to be sufficiently stable during storage
- Its formulation must be cost effective
- The flash point need to be less than 38^0C
- It needs to be efficient for more than one crude oil type
- The oil content of the effluent water after coalescence and separation should be very minimal

Recently researchers focuses on improving the available commercial demulsifiers in terms of higher percentage water separation, reduced residence time, less toxicity profile etc.[1]. As an

example polysiloxane demulsifiers are efficient and ecologically sustainable comparing to commercial demulsifiers. Fig. 2 shows the chemical structure of typical silicone demulsifier [15].

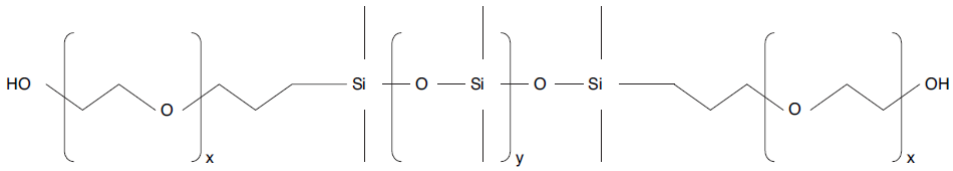

Figure. 2 Chemical structure of typical polysilicone demulsifier [11]

Source: [15]

This chemicals are based on organically modified siloxane molecules and therefore behave significantly differently from traditional emulsion breakers. Sometimes silicone demulsifiers are not replacing organic demulsifiers, but they are improving the effectiveness of phase separation. They can be used at very low concentrations as boosters or to help [16]:

- Improve overall performance
- Increase speed of separation
- Improve interface quality
- Reduce BS&W (basic sediment and water)
- Lower the temperature of demulsification

The biggest advantage of polysiloxane demulsifiers is their lack of toxicity. As it was mentioned most traditional demulsifiers –based on aromatics or nonylphenols are not safe from environmental point of view. Their toxic or mutagenic effects have not been clearly demonstrated, but the increase of environmental constraints makes it necessary to develop safer chemicals [1]. Mechanism of their work is still not well recognized. So far it is known that their amphiphilic characteristic is a major factor for their efficiency [15][17].

The drawback of polysiloxane demulisifers is their high price, but it can change if they are to be introduced on bigger scale. Developing of more green chemical for demulsification is cost effective and environmental friendly process.

Conclusion

The chemical demulsification is complex issue that still needs development of green chemicals. Polysiloxane demulsifiers are believed to be an alternative to the one currently used. In these days, the development of good performance and eco-friendly surfactant for crude oil emulsion breaking will be valuable.

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COMPARATIVE ANALYSIS OF THE QUALITY OF EGGS FROM DIFFERENT SYSTEMS OF BREEDING (ORGANIC AND NON-ORGANIC)

Alicja Ponder*, Król Katarzyna, Klaudia Kopczyńska, Ewelina Hallmann

Katedra Żywności Funkcjonalnej, Ekologicznej i Towaroznawstwa, Wydział Nauk o Żywieniu Człowieka i Konsumpcji, Szkoła Główna Gospodarstwa Wiejskiego, Warszawa

*alicjaponder@interia.pl

Abstract:

The purpose of this study is a comparative analysis of the quality of eggs from different systems of breeding (organic and non-organic). Organic poultry farming is conducted in accordance with the requirements set out in legal regulations. These regulations impose restrictions on possible breeding, feeding and treatment techniques for birds and have been expanded to include the need to select native breeds and carry out farm repairs to ensure appropriate conditions. When running organic farms, rules on animal welfare should be followed. In organic feeding of poultry, plant feed and feed produced in accordance with the principles of organic farming should be used. In organic farming, it is forbidden to use feed from GMO. Scientific research shows that organic eggs have a higher content of omega-3 fatty acids and minerals than non-organic eggs. Organic eggs usually have a smaller weight than conventional eggs. The type of production affects the protein and yolk content in eggs.

Keywords:

organic eggs, organic farming, omega-3 fatty acids, minerals, yolk

Introduction

In the current context of growing consumer demand for foodstuffs that are healthy and safe and that are obtained in a manner respectful to the welfare of animals, the analysis of takes on particular importance. These trends are especially clear in the case of the consumption of eggs because of their strong negative association with cholesterol levels and their extremely intensive systems of production. The introduction of variants that are more in harmony with current consumer demands represents an interesting market alternative [1]. Taking into account the current consumer's demands for animal products with high quality standards, new production systems of laying hens have been adopted in order to guarantee better welfare condition of birds, higher food safety while reducing the environmental impact of the farms. Organic poultry farming is conducted in accordance with the requirements set out in legal regulations. These regulations impose restrictions on: possible breeding, feeding and treatment techniques of birds, and have been expanded to include the need to select native breeds and carry out farm repairs to ensure appropriate conditions. When running organic farms, rules on animal welfare should be followed. In organic feeding of poultry,

plant feed and feed produced in accordance with the principles of organic farming should be used. In organic farming, it is forbidden to use feed from GMO [2].

In conventional breeding, hens are subject to intensive breeding, which allows the use of pesticides and antibiotics. They can have their beaks cut and can be kept in cages without access to natural light. Their feed consists of ready-made mixtures with the addition of synthetic amino acids and antibiotics. Considering the differences between ecological and conventional breeding, a comparative analysis of these two systems has been made in this study.

Characteristics of organic and conventional eggs production

Organic farming cares for the quality of soil, ecosystem and human well-being. It is based on ecological processes, preserves biodiversity. It adapts to local conditions, avoiding causing negative effects. It combines tradition, technology and innovation to provide common environmental and human benefits [3]. The production of poultry is also regulated by the relevant legal regulation. They specify more detailed breeding conditions. The conditions should allow the best possible animal welfare by meeting the needs of the animal species concerned and preventing disease. In particular, attention is paid to the conditions in the animal room, breeding practices, stocking of animals, non-administration of veterinary medicines and synthetic compounds, as well as matching the breed of hens to the housing conditions. Animals must come from organic farms. In organic breeding, hens are to have physiological, developmental and ethological needs satisfied as well as access to free outdoor space. There must be a limit to the number of animals to reduce the negative impact on the environment. There may be no more than 2,500 hens on one hectare of the pasture area, which are divided into groups of 200 or 250. This is related to the effects of animals on the soil [4]. Breeding rules include natural reproduction methods. Hormones or similar substances should not be given to chickens to reproduce. The feed should come from organic farms or farms in the conversion period, it must not contain growth stimulants and synthetic amino acids. Organic fodder is selected in terms of ingredient selection and is more expensive than conventional fodder. In addition, only ingredients allowed in organic farming may be used [3,4].

Conventional production differs greatly from organic farming. It occurs in intensive poultry farms and is targeted at the industrial production of eggs or meat. The conventional production includes cage breeding. Hens lay more eggs compared to the organic production system because they get antibiotics and growth stimulants in the feed. They are kept in cages without natural light, which forces artificial lighting. The feed is obtained from outside the farm. Frequently used supplements are synthetic amino acids, steroids and antibiotics that help keep chickens exposed to stressful factors alive. The feed also contains pesticide residues and genetically modified plants [5]. In animal nutrition in conventional production it is allowed to use growth and productivity stimulants, antibiotics, dyes, preservatives, antioxidants, synthetic amino acids, aromas, sweeteners, or microelements in the form of chylate compounds [4].

Characterization of the nutritional value of eggs

Egg has a high nutritional value and is found in many food products. It contains nutrients such as high-quality biological protein, fats, vitamins and minerals. Chicken egg has an oval shape, narrowed at one end. The size determines the breed, age, and bird breeding conditions. The average

weight is between 40-80 grams, but usually it is about 60 grams.

The egg is composed of a shell, protein and egg yolk. The shell plays a protective role against external factors. Its average thickness is about 0.3 mm. The surface of the shell is covered from the outside with a cuticle that protects the inside of the egg against water loss and penetration of microorganisms [6]. The medium-sized egg provides about 78 kcal and contains about 6.5 g of protein. The fat content is about 5.8 g, in which 2.3 g comes from monounsaturated fatty acids. There are also many important vitamins and minerals. Egg is a source of vitamin A, folic acid, choline, phosphorus, selenium, vitamin D, riboflavin, vitamin B12, biotin and iodine. [7]. Egg weighing 60 grams consists of 29% yolk (17,4g), white 61.5% (36.9g) and shell 9.5% (5.6g) [5]. The white contains 88% water, 10.5% protein and 0.5% mineral compounds. 60% of the dry matter of yolk is a fat component, with saturated fatty acids dominating in it. The share of polyunsaturated fatty acids is smaller, most of which is linoleic acid with a lower proportion of linolenic acid [8].

Eggs are subject to the quality classification specified in legal regulation. There are three classes of commercial quality of eggs.

• class A - fresh eggs, their air chamber size is less than 4 mm. A distinction is also made of fresh eggs during 9 days from laying.

• class B - fixed eggs that have been cooled to a temperature below 5 degrees Celsius using cooling, limewater or a mixture of gases differing in composition from the composition of atmospheric air.

• class C - eggs for use in industry or agri-food processing

In addition, the weight classification is also used. There is a division into egg class:

• S - weighing less than 53 grams
• M - weighing from 53 grams - 69.2 grams
• L - weighing 63 grams - 72.9 grams
• XL - weighing over 73 grams

Objective of the study

The aim of the study was a comparative analysis of the nutritional value of eggs from organic and conventional production based on a review of the current literature. It presents the characteristics of organic and conventional production as well as the nutritional value of the chicken egg. The study is based on a review of foreign publications on the issues discussed, found in traditional libraries, as well as the use of electronic databases

Results

Comparison of the nutritional value of eggs from organic and conventional farming

Studies carried out so far pay attention to the impact of the breeding system on production volume and various egg quality parameters, such as egg size, composition of individual components, color, as well as nutritional value. The Elwinger et al. [9] study compared the Lohmann Selected Leghorn and Swedish Hen breeds, intended for conventional breeding, with Rhode Island Red and White Leghorn hybrid breeds used in organic farming. Parameters such as the egg production volume and individual behavior in the organic production system were examined. It has been shown that conventional breeds are able to adapt to ecological conditions. The breed of chickens can also

affect the content of certain nutrients. In the Anderson study [10] it was shown that eggs from laying hens bearing white eggs had a larger egg yolk compared to eggs that were fed by hens giving brown eggs. Brown eggs contained more protein in the mass. In the Ovwigho et al. [11] study, greater egg weights and protein content were found in conventional production, which is associated with the use of feed with additives.

Egg size is an important parameter taken into account in the qualitative assessment. It is dependent on the lay and the rearing system. Eggs from cage production were usually classified as A, while eggs from organic farming were usually classified as B [10].

The nutritional and energy value of food, especially the content of protein and amino acids, also play a large role. Together with increasing the share of these components, the volume of egg production increases [12]. This was confirmed by Koreleski and Świątkiewicz [13] in a study showing that the addition of methionine to feed in ecological farming may increase non-fertility. The work of Hammershoj and Steenfeldt [14] examined the effect of certain additives on feed on the production of eggs. The influence of healing kale, basil and thyme on the ecological production of eggs was investigated. 300 Lohmann Silver hens for 5 weeks received feed supplemented with the mentioned ingredients. The results showed that the addition of thyme and kale significantly increased the number of laying eggs and their quality parameters.

Organic and conventional eggs differ significantly in the content of macronutrients (proteins, fat, carbohydrates) and the total dry matter content. A study by Matt et al. [15] confirmed the existence of these differences. His task was to compare the content of egg nutrients from ecological and conventional breeding. The content of carbohydrates, cholesterol, fatty acids, protein, sodium, potassium as well as the content of dry matter and vitamins were taken into account. The study material consisted of HyLine Brown chickens from ecological breeding aged 246 days and chickens from conventional breeding at the age of 257 days. The hens in organic production were fed ad libitum. Organic feed consisted of hay, cereal products, vegetables and roughage depending on the season. The hens had access to a free range. Conventional fodder contained cereal-based products with additives. It was administered in an amount of 110-115 g per day. The hens from conventional breeding were kept in cages of 1000 cm² per piece and 40 cm in height. Each test sample consisted of 20 eggs. The table 1 contains a pledge of the amount of nutrients in eggs from the compared rearing systems.

Table 1. Average content of the qualitative parameters under examination and standard deviation in eggs from ecological and conventional breeding.

Parameter	Conventional production	Organic production
Energy value (kcal/100g)	133	127
Total carbohydrates (%)	1.01 ± 0.1	1.9 ± 0.25
Total protein (%)	12.35 ± 0.49	11.9 ± 0.48
Cholesterol (mg/100g)	341	489
NKT (%)	2.5 ± 0.2	2.3 ± 0.1
JNKT (%)	3.2 ± 0.3	3.2 ± 0.3
WNKT (%)	1.6 ± 0.2	1.1 ± 0.1
WNKT n-3 (%)	0.2 ± 0.2	0.1 ± 0.01
WNKT n-6 (%)	1.4 ± 0.2	1.0 ± 0.1
Potassium (mg/100g)	122 ± 25	131 ± 27
Sodium (mg/100g)	134 ± 20	131 ± 20
Calcium (mg/100g)	38.2	13.6
Dry matter (%)	23.15 ± 0.23	22.6 ± 0.23

Source: Matt D. Veromann E. Luik A (2009): Effect of housing systems on biochemical composititon of chicken eggs. Agronomy Research. 7II. 662–667

Organic eggs contained more carbohydrates. and conventional eggs had more dry matter. total fat and protein. Cholesterol content was 30%. and potassium was 7% higher in organic eggs. However the Vilà [16] study showed that the amount of cholesterol in the egg is positively correlated with the mass of yolk and negatively correlated with the amount of eggs being laid. In the work of Matt et al. [15] organic eggs contained more cholesterol. They had smaller yolk and mass than conventional eggs. Opposite results were obtained by Wang et al. [17], where in cages the cholesterol content was 19.4% higher than in ecological farming (10.32 ± 0.48 mg / g, 8.64 ± 0.40 mg / g , p-value <0.05).

The Ferrante et al. [18] study compared the impact of litter and ecological systems on specific egg quality parameters. The research material comprised 4,745 hens kept in a bedding system and 2,016 hens bred in the ecological system. All chickens were Hy-Line Brown. The average weight of eggs, shells and proteins in dairy farming was higher than in organic farming, which resulted from the greater weight of the egg itself. The yolk weight of organic eggs was higher than that of conventional eggs, indicating a higher nutritional value of organic eggs. The egg yolk contains nutrients valuable from the nutritional point of view. The work of Minelli et al. [19] similarly tested the effect of a breeding system on the weight and content of egg components. The test material consisted of 1,400 eggs from both production systems. The results confirmed that organic eggs have a lower weight, but a higher proportion of protein and yolk in the mass, which may indicate their greater nutritional value.

Hidalgo et al. [20] study showed higher protein content in organic and free-range eggs. They also had better foaming properties compared to caged eggs. Organic eggs had a higher protein content than caged eggs, taking into account differences in dry matter. The height of the air chamber of ecological and free-range eggs was the highest, and the height of the dense low protein, which indicates the aging of the egg. Bedding and cage eggs had a smaller air chamber. This may have been due to environmental conditions during storage and transport such as temperature and relative humidity. On the other hand, the cage eggs had the thinnest crusts and the most frequent ones were bruises. The share of the shell in the mass of the whole egg was the least in the case of organic and free-range eggs, which meant a greater concentration of edible components.

The nutritional value of organic eggs is influenced by a specific diet of chickens. Mugnai et al. [21] examined the impact of the system of breeding and consumption of grass on the nutritional value of eggs. The research material were eggs from 360 Ancona hens. The duration of the study was one year. The hens were divided into three groups:

• conventional group, control group (C) - hens were kept in cages in standard conditions,
• organic group (O) - hens kept as part of the organic production system (4 m2 / hen),
• ecological group plus (OP) - chickens kept in ecological conditions, but with greater access to grass (10m²/hen).

The highest content of bioactive compounds in feed and grass occurred in spring, summer and autumn. Flavonoids, alpha tocopherol, carotenoids, mainly zeaxanthin, 90% lutein and beta carotene had the largest share in conventional fodder. The grass in the organic fodder contained little dry matter, more fibers and antioxidants in the form of carotenoids, flavonoids and tocopherols compared to conventional fodder. The violaxanthin pigment alongside lutein was the largest proportion of carotenoids in the grass. Grass is a valuable source of antioxidant compounds in ecological farming due to the ban on the use of synthetic vitamins. The study showed that the amount of grass consumption depends on the season of the year and the stocking density of the animals in the pasture. The highest consumption occurred in the spring. The hens in the ecological system had access to fresh grass, which had a positive impact on the nutritional value of the laying eggs compared to conventional chow. The study also showed the impact of the breeding system on the size of the lay. In ecological farming, the lay rate was 60.6%, in ecological farming plus - 59.6% and in the control group - 70.9%. Obtained differences were probably due to the smaller protein consumption of chickens in organic farming, especially in production with increased access to grass, as a result of high grass consumption. In addition, the hens had a higher energy expenditure related to the movement, which could also be associated with lower egg production. An important aspect included in the egg quality assessment are shell parameters. The papers mainly concern the study of the correlation between supplementation with specific components and qualitative parameters of the shell.

The work of Giannenas et al. [22] concerned the measurement of the content of trace elements in eggs from cage, free-range and ecological breeding. The content of trace minerals such as selenium, zinc, manganese, cobalt, copper, molybdenum, chromium, nickel, arsenic and cadmium in protein and egg yolk was measured by means of mass spectrophotometry. Chickens in free-range and conventional production were fed feed intended for a specific rearing system with the addition of micronutrients. The hens in organic production were fed with grass, cereals and vegetables. The content of individual mineral components varied depending on the production system. The content of selenium, zinc, manganese, cobalt and copper was lower in free-range eggs compared to the compared breeding systems. The amount of chromium was the highest there. In addition, the concentration of minerals was higher in yolk than in egg white. The highest content of selenium and chromium occurred in egg yolk from organic production. The highest concentration of zinc occurred in the egg yolk from the free range, then in the eggs from conventional production and eggs from organic production. The content of cobalt, copper, molybdenum, nickel, arsenic and cadmium did not differ significantly in the compared rearing systems. Testing the content of trace minerals is important due to the environmental pollution aspect. The study did not observe any exceedance of the permissible levels of contamination in eggs in any egg production system.

However, there are studies showing higher pollution of heavy metals in free-range eggs. The general conclusion from the study was to show the impact of the production system on the content of trace elements. The feeding method of hens was of fundamental importance. In the free-range and ecological production, the availability of stones and grasses may increase the presence of some elements in the egg [23].

Conclusions

Summarizing the collected literature data, it can be stated that there are qualitative differences between eggs from organic and conventional production. These relate to physical parameters such as egg weight, shell thickness, yolk color and chemical composition parameters. Organic eggs were characterized by a higher content of mineral components compared to eggs from conventional breeding. This indicates a higher nutritional value of organic eggs compared to eggs from other production systems, but this issue requires further research.

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PSYCHOLOGICAL NEEDS (H.A. MURRAY) AS PREDICTORS OF SPECIFIC BEHAVIORS (CHOICES OF A PARTICULAR TYPE OF TEACHING PROFILE OR A SPECIFIC FIELD OF STUDY)

Elżbieta Trylińska-Tekielska*, Robert Paweł Stachowicz, Aleksandra Marianna Zmuda

Katedra Psychologii Medycznej, Wydział Rehabilitacji, Wyższa Szkoła Rehabilitacji w Warszawie

*etek@poczta.onet.pl

Abstract:

The topic of the article (presentation) is the issue of psychological needs (H.A. Murray, 1938) understood as a hypothetical force located in the brain, stimulating action and giving a specific direction of action. High saturation of the psychological need "forces" the individual to unload and equalize mental homeostasis. In the research, psychological needs were treated as predictors, determinants of decisions made regarding the choice of the direction of interests.
The subject of psychical needs treated (perceived) as a theory of motivation were dealt with (Murray, Maslow, Gasiul, Siek, Miler-Zawodniak). The research was carried out in March 2017- by the self-portrait of Stein (in the direction of Choynowski) - on the group (N = 66) of the students of the post-primary school classes with profiles: medical rescuer, dietitian.

Keywords:

psychological needs, youth, psychology, paramedic, dietetics.

Introduction

The aim of the research was:

1. checking which of the psychological needs in the studied groups are the most strongly declared and can be treated as directing to specific activities (selection of the class profile and continuation in studies),

2. how occurrence of increased mental needs in both groups may (but does not have to) influence the functioning of these groups.

The whole studied population of youth was from one school.

It was assumed that students from the paramedics class will show the need to help (as indispensable in this profession) and will declare the need to associate (willingness to be with people).

In the group of students from the dietetics classes, it was assumed that the cognitive need would be strongly declared (getting to know more and more reliable, tested methods of nutrition) and the need for pleasant sensory experiences connected with taking pleasure eg from well-prepared food.

The age of students (16-17 years) and age-specific needs, eg fun and sexual, were also taken into account.

The hypothesis was made.

H_1: Students in the medical paramedic class will have a strong need to help

H_2: Students from the dietetics profile classes will show a strong need for creativity, cognitive, pleasant sensory experiences declared in the group of paramedics is the need to help others, association

2. The psychological need most strongly declared in the dietetics group is associate, help others, compensate

Therefore, it can be concluded that the hypothesis regarding the gratuitous group was confirmed. However, the hypothesis regarding gr. dietetka did not obtain confirmation.

Description of the results obtained

A summary of the research conducted on the population = 66 people with the help of "Self-Portrait of Stein" (in Choynowski's study).

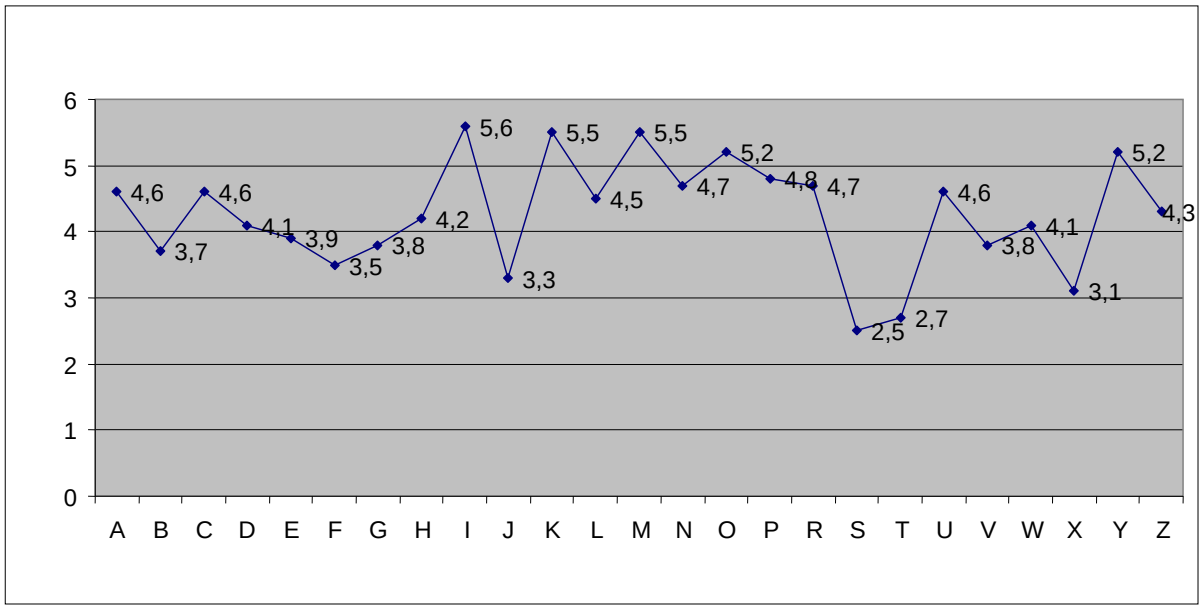

Figure 1. Average overall results for psychological needs in the entire population
Increased need
Types of needs
Source: own elaboration

On the basis of the results obtained, Stein's Self-Portrait can be stated that in the entire population the highest declared the needs were: the need to associate (I), help (K) play (M) compensation (Y) and sex (O). The lowest were assessed information needs (B), fear of physical injury (F), need submission (J), isolation (S) and aggression (T). This means that in the study group the subjects like to be with each other, have common themes to conversations. They are characterized by trust in people, they believe in their good will. They have a desire meeting new people.

They show sensitivity to others, want to help, comfort, see poverty, they are caring, they show a humanitarian attitude. Characteristic for this group fun (M) can be associated with the age of the subjects and can tell us about willingness to relieve tension. There is a strong need for compensation (Y), which may be a difficult result experiences or past experiences associated with a sense of harm and injustice. Subjects tend to overcome their own failures through action and willingness to maintain respect for oneself. They are also characteristic determination in action, willingness to act on your own strength. The group does not declare high the need for aggressiveness which may interfere with the need for compensation. Based on the results obtained in the field of psychological needs declaration of the entire population studied, it can be stated that the association, help, compensation are characteristic of this group.

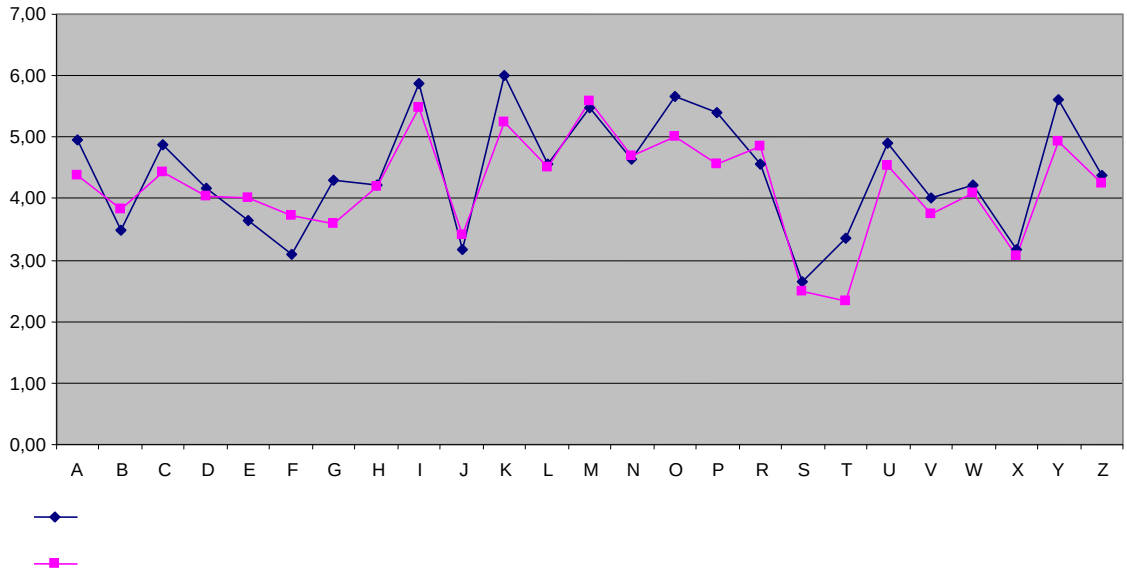

Figure 2. The average difference between Dietetics and Lifeguards in Stein's self-portrait
Type of needs
Source: own elaboration
average dietitians
average lifesavers

Based on the results obtained, Stein's self-portrait can be said that in the group of dietitians, the needs of (I) need to associate the most were noticed, (K) the need to help others, (O) the need for sex and (Y) the need for compensation. The lowest in this group was (S) the need for isolation, (X) the need for humiliation, (F) fear of physical injury and (J) the need for submission. In the group of medical rescuers, the most-needed ones were: (M) need to play, (I) the need for association, and (K) the need to help others. The lowest was recorded (T) the need for aggression, (S) the need for isolation, (X) the need humiliation and (J) the need for submission.

On the basis of the results of the declared mental needs, it can be stated that in the group of dieticians the most marked are the association, help and compensation.

In the group of paramedics there is also a strong association, help and fun Initial hypothesis H_1: Students in the medical rescuer classes will show a strong need to help - she has been confirmed

$H_{2:}$: Pupils from the dietetics profile classes will show a strong need for creativity, cognitive, pleasant sensory experiences - it has not been confirmed. The research also drew attention to the possible differences between men and women in the dietetics group and in the paramedic group.

The results in declared needs (dietetics) are presented below.

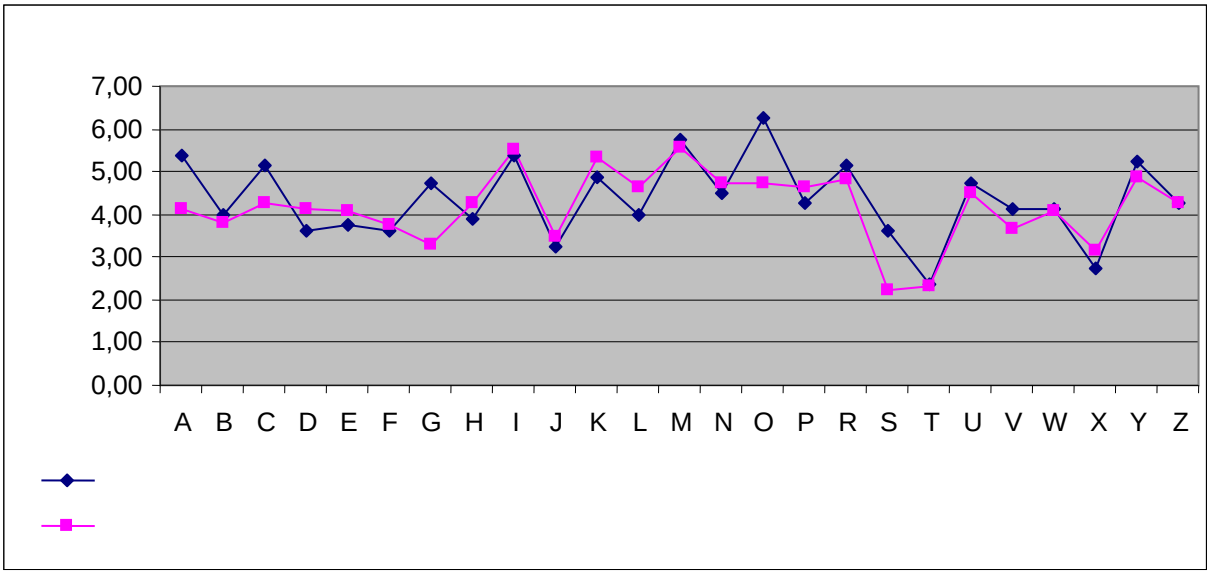

Figure 3. Comparison of men and women dieters according to self-portrait of Stein
average male dietitians
average women dietitians
type of need
Source: own elaboration

On the basis of the results obtained in the Stein Self-Portrait examining mental needs, it can be stated that:

1. In the group of men dieters:

- the needs of: (A), sex (O), play (M), association (I), cognitive (C) and possession (G) were assessed.
- the following were assessed: aggression (T), humiliation (X), submission (J)

2. In the group of women dieters:

- the needs of association (I), looking after (K), play (M), independence (R), compensation (Y) were assessed first.
- the lowest were assessed the needs of: aggression (T), isolation (S), humiliation (X), acquisition (G), submission (J).

3. The biggest differences and discrepancies in the assessment of needs in the groups of women and men dieters are observed in the needs of:

- (A), cognitive (C), acquisition (G), sex (O), which men judged much higher than women.

-Women, on the other hand, rated the following needs above men:

creativity (D), the need for security (E), looking after (H), order (L), (these differences, however, have lower saturation).

The dominant group in the dietitian direction are men especially that the need for feat is important.

The results of saturation of mental needs in the group of women and men are presented below

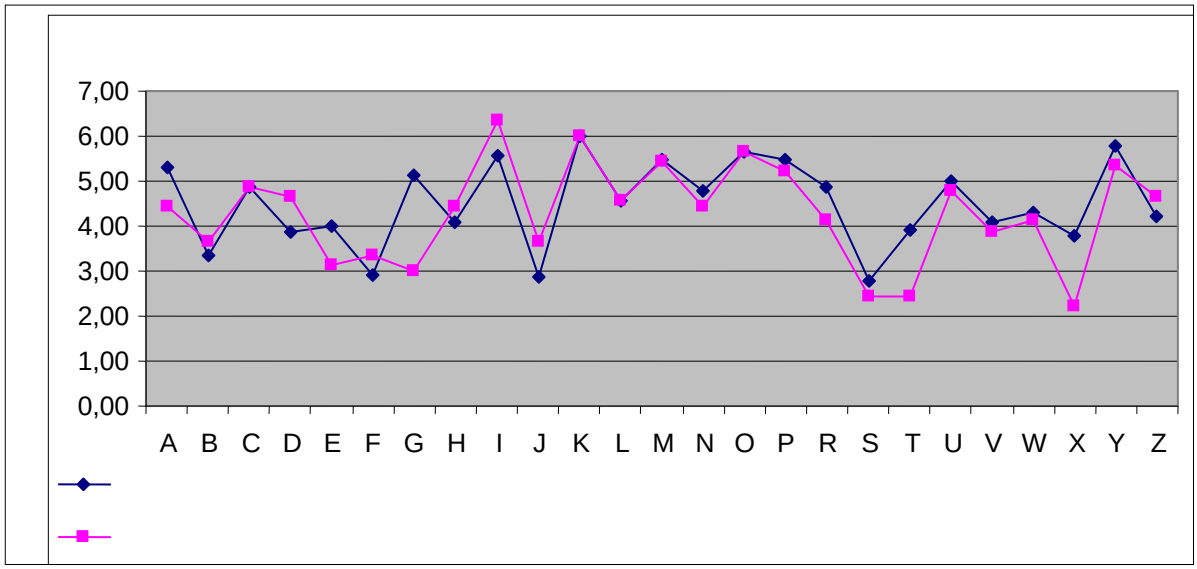

Figure 4. Comparison of men and women rescuers according to self-portrait of Stein
average male rescuers
average female rescuers
type of need
Source: own elaboration

The highest declared needs were: association (I) - higher in women than in women, men and taking care of (K), play (M), sex (O) and compensation (Y). In the group of men, higher saturation (than in women) was needed to make and possess. It can be concluded that in the studied group, women stimulate the desire to be together and with others. They are characterized by trust in people, they believe in their good will. They have a great desire to meet new people. They show sensitivity to others, want to help them, comfort them. Women are less aggressive from men who want to compete, achieve and gain. There is a strong need for compensation (Y) in both women and men, which may be the result of difficult experiences or negative experiences related to feelings of wrong and injustice.

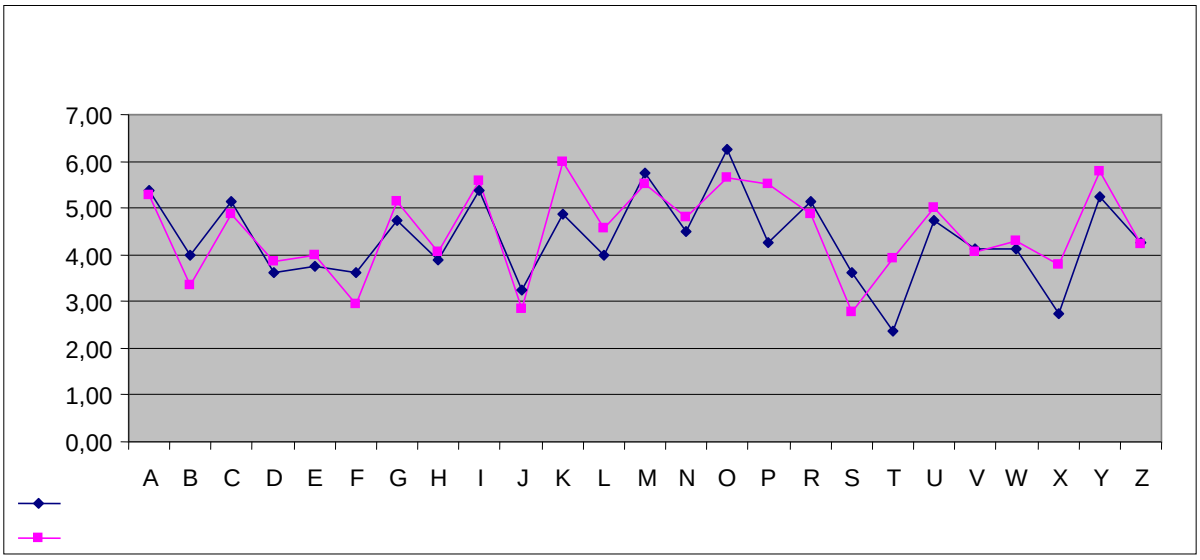

Figure 5. Comparison of Men dietitians and Men rescuers according to self-portrait of Stein
average male dietitians
average men of rescuers
type of need
Source: own elaboration

Based on the self-portrait of Stein, comparing a group of men (dietetics) and a group of men (a paramedic). It can be concluded that:

Lifeguards are characterized by:

-High willingness to help others (K)
-High compensation need (Y)
-High need for association (I)
-No need for isolation (S)
-Low submission (J)
-A low anxiety of physical injury (F)

Nutritionists are characterized by:

-High sexual need (O)
-High need for fun (M)
-No need for aggression (T)
-The low need for humiliation (X)

Based on the obtained results, we can conclude that paramedics put on effective action in the group oriented at helping others. They have no fear of physical injury thanks to which they can operate without inhibitions even in extreme situations

A group of dieters has high sexual needs, but this is adequate to their age. When it comes to the need for fun, it is a natural need to relieve emotional tension. Thanks to their joyful approach, they can establish a good relationship with another person while their level of aggression remains at a very low level.

In the group of men, attention is paid to a greater saturation of needs in the medical group which may affect the functioning of both groups.

In the Greek medical system, there are two psychological needs, mutually exclusive, which can lead to internal conflicts with their high saturation. They help to provide care and support.

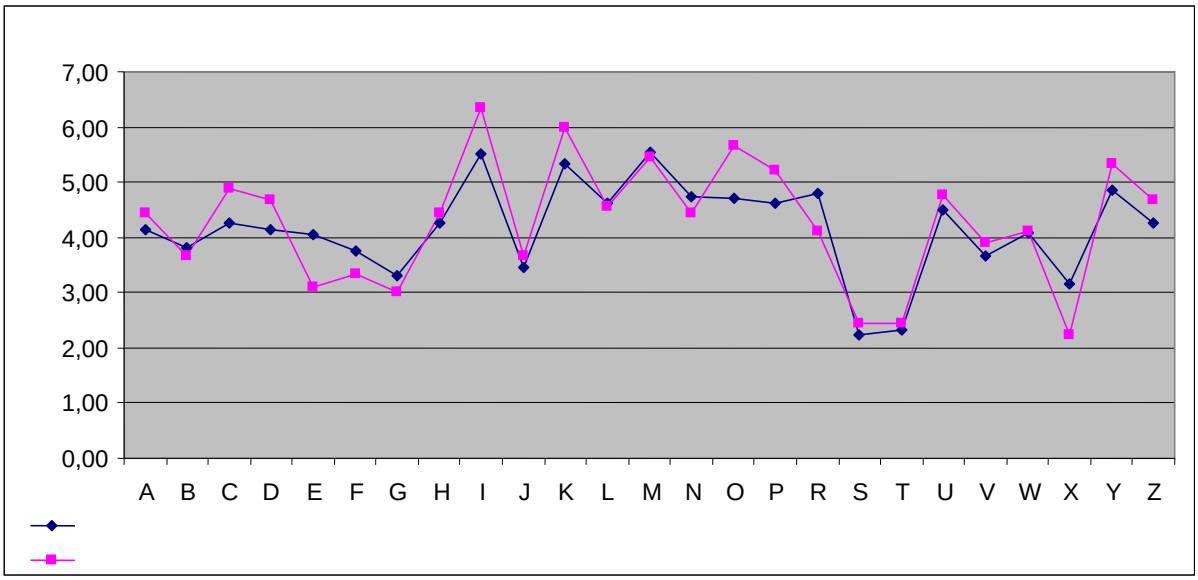

Figure 6 Comparison of Women dietitians and Women rescuers according to self-portrait of Stein
average female dietitians
average female rescuers
type of need
Source: own elaboration

On the basis of the results obtained in the Stein Self-Portrait, it can be stated that the highest results of Women from rescue have reached such places as the need for I - association, K - caring and O - sex. The lowest results in this group have reached such needs as S - isolation, T - aggression and X - humiliation.

The highest results of women from dietetics have reached such places as the need for I - association, K - caring and M - fun. The lowest results in this group have also reached such needs as S - isolation and T - aggression and X - humiliation.

This means that in the surveyed group, individuals like to be with each other, talk, share topics. They are characterized by trust in people, willingness to help and help. In women dieters, the need for sex which was the highest in rescuers was turned into a need for fun.

In the group of women (paramedics) one can notice the occurrence of a contradictory tendency, a high need to help others while also (also high) occurrence of the need to receive help and care.

In the group of women (dietetics), there is a strong fear of physical injury and before being settled by others. This rules out the feeling of security in this group.

Conclusion

On the basis of the results obtained in the Stein Self-Portrait, in the studied population of students from the profile of a paramedic and a dietician, it can be said that

1. Mental needs declared in the entire population confirm the predisposition to interests in the direction of a medical doctor.

2.The group of the surveyed adolescents with a dietetics profile did not show any features characteristic of this profession.

3. The group that imposed the style of action (due to the declared needs) was the medical rescuer group.

4. In the dietician's group, strong common needs related to -offs and learning about the world.

5. In the group of a paramedic, women were moving towards the association, men towards accomplishments.

6. Men (insurance) showed a stronger saturation of many needs
Men (dietetics) showed a stronger p. Seksu.

7. Women (insurance rate) showed a sober tendency of actions.

8. Women (dietetics) showed a strong disturbance to the need for security.

Discussion

The work focuses on the mental needs as determinants (stimulators) of activities that allow predicting specific behaviors as well as on needs that may lead to conflicts in the group. Previous studies on mental needs take into account the influence of some needs on physical condition and achievements eg in sports groups [5] or pay attention to the relationship with occupational burnout [6,7]. Some of the authors investigate conflict in teams at work, but this is not based on Murray's theory "and hence conclusions or forecasts are not reliable [8].

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FREQUENCY OF BACK PAIN IN PHARMACISTS IN THE ŚLĄSKIE VOIVODESHIP

Rafał Uciński*, Anna Fyda, Dariusz Górka

Zakład Medycyny Sportowej i Fizjologii Wysiłku Fizycznego, Wydział Nauk o Zdrowiu, Śląski Uniwersytet Medyczny w Katowicach

*rafal.ucinski88@gmail.com

Abstract:

Spinal pain is one of the most common dysfunctions causing limitation of activity, whether professional or everyday. However, pharmacists are also a professional group exposed to back pain. The research group consisted of 75 women working in a pharmacy. People work in various pharmacies of the Silesian Voivodeship. During their work, they perform a variety of activities that can cause or worsen spinal pain. After the analysis of the questionnaire, it was shown that work in a pharmacy can promote the occurrence of pain in the spine. Most of the respondents stated that the pain was discriminated against by the standing position of 71%, and the seating position was marked by 11%. Carrying contributes to pain in 35% of the respondents. Work in a pharmacy predisposes to the formation of back pain syndromes. All measures should be taken to introduce more control over the ergonomics of the pharmacist's workplace to avoid multiplying the number of patients.

Keywords:

back pain, long standing position, spine, discrimination pain, spine diseases

Introduction

Spinal pain is one of the most common dysfunctions causing limitation of activity, whether professional or everyday. However, pharmacists are also a professional group exposed to back pain. The spine is the basic element of the motor apparatus. Dysbalans of muscle tension and disorders in motor control cause disorders of spinal biomechanics. Which results in overloads resulting in discrimination of pain. The close connection to the correct mechanics of the spine structures has the central nervous system through neuromuscular control. The voltage ratio is proportional to the value of the forces acting on the spine. Shear forces affecting the structure of the spine cause destruction and disruption of work leading to degenerative changes and feelings of pain. Another factor causing back pain may be undiagnosed or untreated posture, leading to a change in the biomechanics of myofascial chains. The lumbar-sacral section is the most frequent localization of spinal pain. The pain in some of the respondents is diffuse, which is associated with discomfort in other regions than just the problematic section of the spine. Pathological changes that may cause pain in a given section of the spine include hernia and degeneration of the intervertebral disc, degeneration of inter-pole joints, spondylolisthesis, canal stenosis and instability. Magnetic resonance imaging is not a

good basis for making a diagnosis because some of the respondents may experience pain in spite of the lack of changes in the image of the spine. In the opposite direction, clear changes in the magnetic resonance image do not have to be translated into the patient's clinical condition.

The work of a pharmacist is associated with a longer stay in a standing position. This position can be regarded as the end of the range of motion, which in combination with the amount of time spent in such a position can lead to structural overloading. The workplace is usually not adapted to the preservation of ergonomic principles, resulting in more frequent pain syndromes.

The aim of the work was to examine what activities and which items affect the occurrence of spine pain and how they affect professional activity and everyday life.

Materials and Methods

Materials

To obtain the research material, an original questionnaire was used, filled in by pharmacists working in public pharmacies in Silesia. The criterion for selecting the group were women working in a pharmacy as a pharmacist and pharmacy technicians. Prior to the study, permission was requested to conduct research with the heads of the facilities in order to conduct a questionnaire survey. The survey was conducted between 1 and 30 March 2018. A total of 80 questionnaires were distributed, and 75 questionnaires were received and evaluated. The survey consisted of 23 questions, 19 closed one-choice questions, 4 multiple-choice closed questions. The criteria of the questionnaire contained, among others, questions about:

- age,
- weight
- body height,
- type of inhabited locality,
- determining the time spent at work,
- the occurrence of faulty postures and whether they have been corrected,
- does the work discriminate against pain,
- the location of pain,
- time of pain,
- the impact of back pain on the activity of patients,
- forms of pain treatment,
- diagnostics in order to find the cause of pain,
- the most common positions causing pain in the spine.

Methods

Based on the conducted questionnaire study, a series of analyzes was carried out to determine the relationship between the occurrence of pain and the profession. The statistical analysis was based on Microsoft Excel 2010 and the statistical statistical package Statistica 13.1. With the help of Statistica 13.1. analysis of basic descriptive statistics was performed. The level of statistical significance was $p < 0.05$.

Characteristics of the research group

The study group consisted of 50 women aged 20-40 years (67%), 22 pharmacists aged 41-60 (29%). Three persons were a group from the age above 61 (4%). 37 women working in the pharmacy gave birth to children (47%). The working time of tested pharmacists is presented in the table below.

Table 1. Quantitative and percentage presentation of working time

Work time	The number of pharmacists	Percent
8 h	52	69
8-12 h	17	23
>12 h	6	8

Source: obliczenia własne

Results

After the analysis of the questionnaire, it was shown that work in a pharmacy can promote the occurrence of pain in the spine. Most of the respondents stated that the pain was discriminated against by the standing position of 71%, and the seating position was marked by 11%. Carrying contributes to pain in 35% of the respondents.

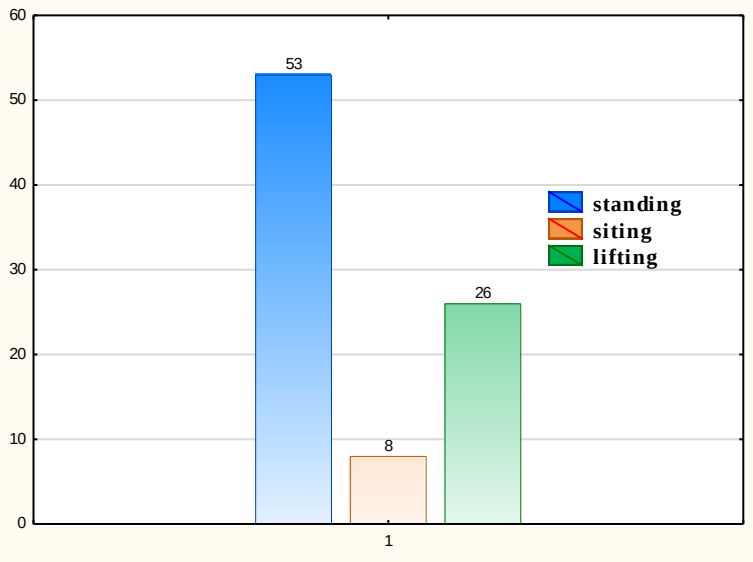

Figure 1. Activities that discriminate against pain,
Source: own calculations

In connection with the work performed, 63 pharmacists report pain (84%). Four people do not feel any pain at work (5%). Eight women surveyed feel pain outside the workplace (11%). (Figure 2.)

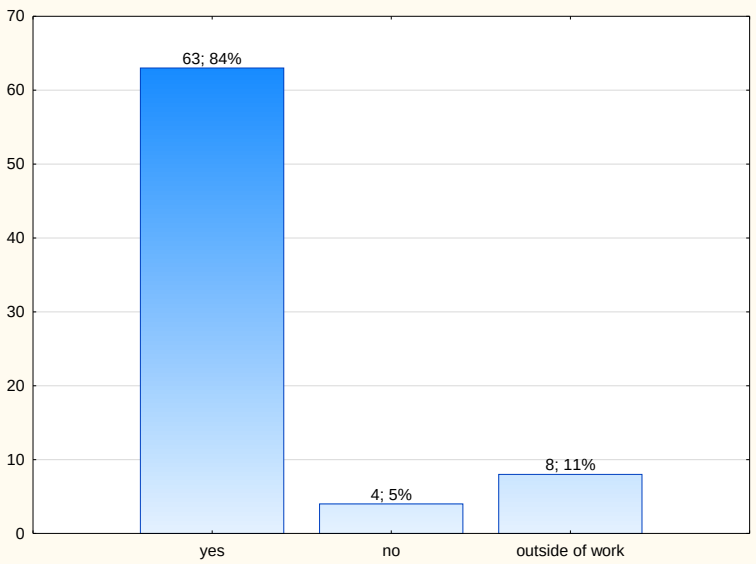

Figure 2. Does working in a pharmacy cause back pain?
Source: own calculations

In most cases, 39 people show painful cervical spine pain (52%). 17 people have pain in the thoracic spine (23%). 36 respondents have pain in the lumbar region (48%). The cross-section was the least painful, 6 people (8%) (Figure 3.).

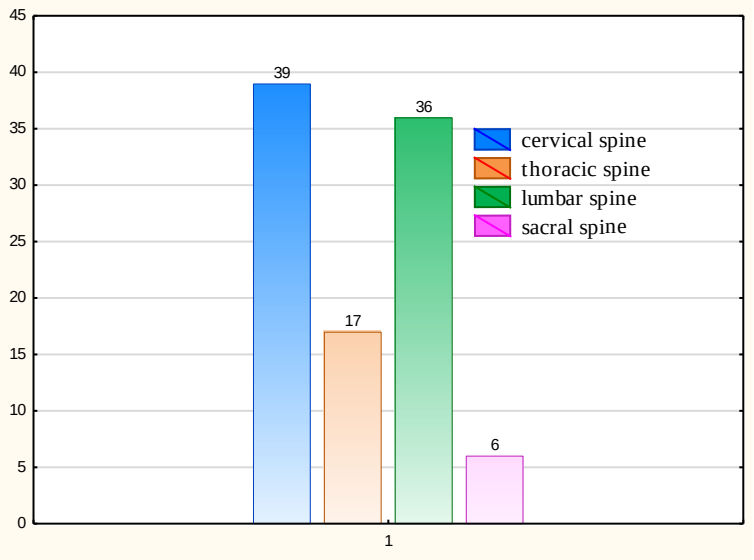

Figure 3. A painful section of the spine.
Source: own calculations

Figure 4 shows the periods of occurrence of pain in pharmacists. 9 women experienced pain for the first time (13%), 45 of those polled feel pain in a period of one to five years (63%). 14 respondents feel pain from 6 to 10 years (20%), 3 people feel pain above 10 years (4%).

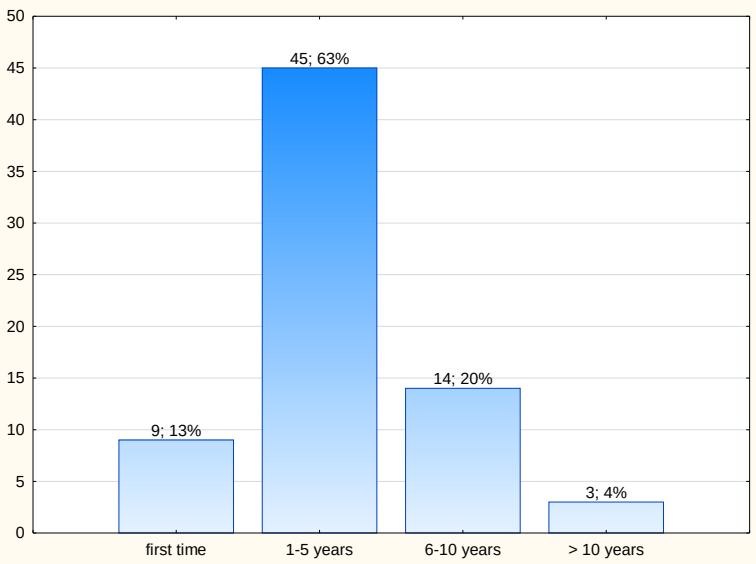

Figure 4. The period of spine pain
Source: own calculations

Most respondents consider moderate pain (62%). 19 people consider pain to be light (27%). 8 respondents describe their pain as strong (11%) (Figure 5.).

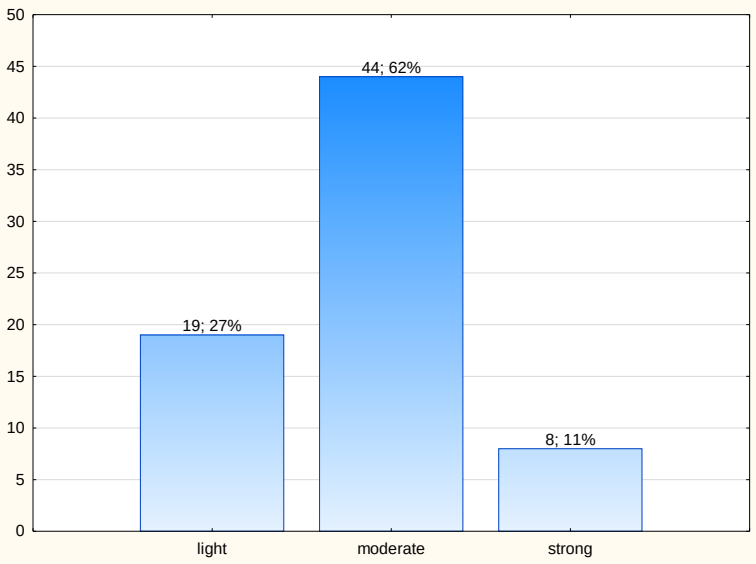

Figure 5. Pain characteristics
Source: own calculations

Figure 6 presents the value of using pharmacology in eliminating pain. 43 patients benefit from medication (61%). 4 women do not help drugs (6%). In 15 respondents, drugs show a short-term effect (21%). In 9 people there is no need for medication (13%).

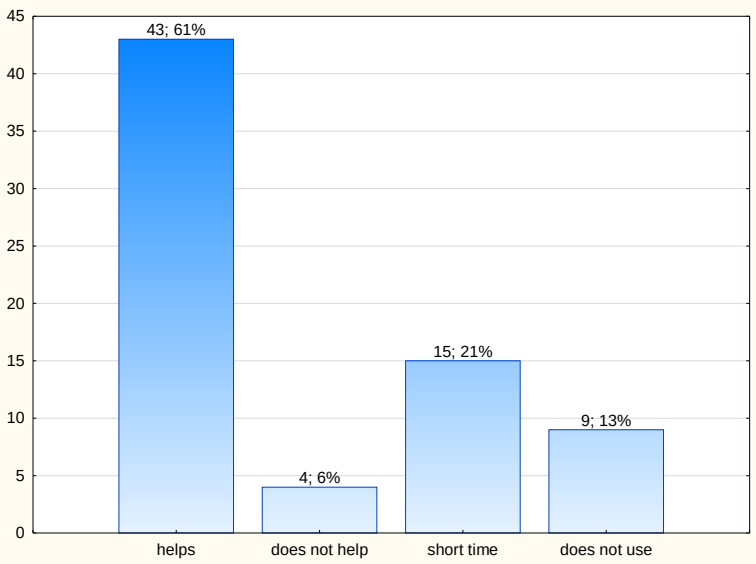

Figure 6. The use of pharmacology
Source: own calculations

Figure 7 shows the correlation of the applied physiotherapeutic treatments and the effect of their application. In 17 people, pain complaints decreased (85%). Physical treatments were not reflected in effectiveness in 3 patients (15%).

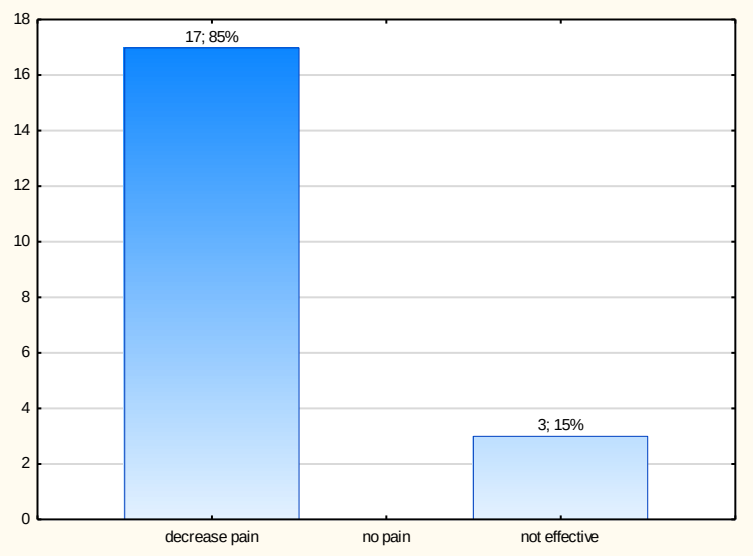

Figure 7. Efficiency correlation physiotherapy
Source: own calculations

Figure 8 illustrates the occurrence of other ailments besides spinal pain. 29 respondents report limb pain, 17 people feel tingling. 3 people have a sensory disorder, 1 person has mobility problems. 34 pharmacists did not report other ailments.

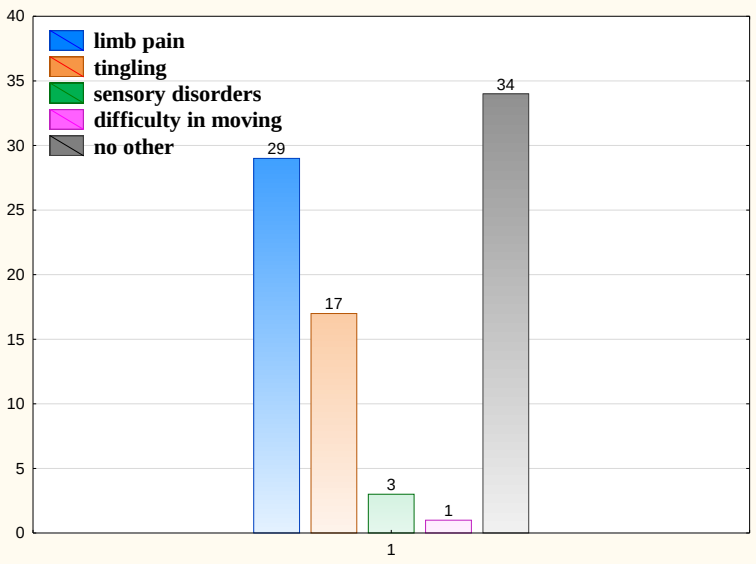

Figure 8. Other ailments.
Source: own calculations

Figure 9 presents diagnostic tests carried out by the respondents. 29 people took an X-ray picture. 4 people have a computed tomography. 7 people performed magnetic resonance. In 10 women a neurological examination was performed. 40 patients did not perform any diagnostic tests.

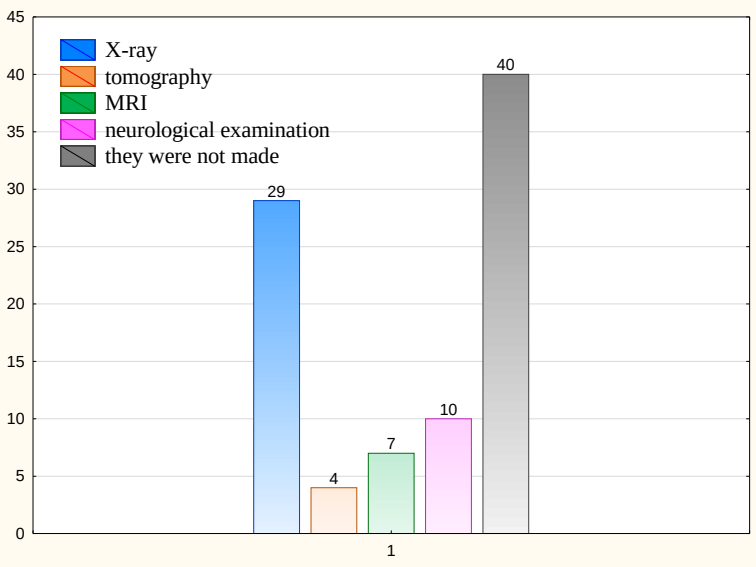

Figure 9. Diagnostic tests.
Source: own calculations

Figure 10 presents diagnosed problems in the surveyed pharmacists. Five of them were diagnosed with discopathy. Most patients have degenerative changes of the spine - 20 people. 9 subjects have curvature of the spine. 2 people have other disease entities.

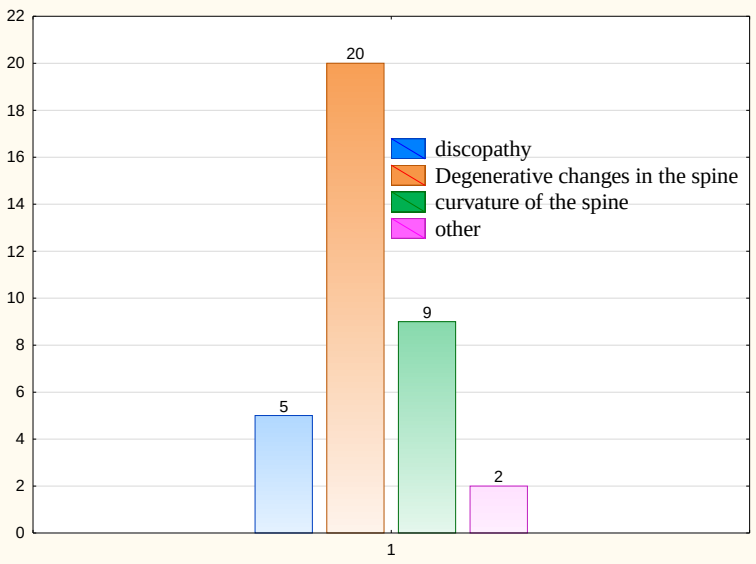

Figure 10. Diagnosed disease entities
Source: own calculations

Conclusion

Work in a pharmacy predisposes to the formation of back pain syndromes. All measures should be taken to introduce more control over the ergonomics of the pharmacist's workplace to avoid multiplying the number of patients. Most pharmacists complain of spine pain in connection with long-standing standing position. The resulting situation is influenced by the working time and the adjustment of the workplace to the employee. Research shows that the biggest problem with pain is in the cervical spine. Presumably, it may be influenced by the increased neck involvement associated with the digitization of consumer goods. The next group is pain in the lumbar region. It is associated with muscular tension dysbalance, which is the reason for the overloading of spinal structures. The emerging pain syndromes are also influenced by undiagnosed and poorly corrected postural defects leading to disorders in the biomechanical system. The adding number of overloads per unit of time is the cause of degenerative changes in the spine, which, as shown by the respondents, is the prevalent disease entity among the respondents. It would be necessary to increase the self-awareness of the examined women regarding the diagnosis of the spine pain problem in order to accurately determine the cause of the discomfort and to choose the therapy for the patient.

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THE POSSIBILITY OF USING PMCT IN CPR-RELATED INJURIES

Aleksandra Walczak

SKN Młodych Medyków Sądowych, Katedra i Zakład Medycyny Sądowej Uniwersytetu Medycznego im. Karola Marcinkowskiego w Poznaniu

aleksandra.i.walczak@gmail.com

Abstract:

CPR is the basic emergency procedure in life-threatening situations, but carries the risk of a number of injuries. The most common are chest injuries, including rib and sternum fractures. Their appearance after resuscitation depends on age, sex, experience of the person conducting CPR and the duration of CPR. In addition, internal organs may be damaged, including the heart, lungs or liver with the presence of pericardial, pleural or peritoneal haemorrhage. This type of injury can significantly hinder the determination of the cause of death. To determine it with greater accuracy it is possible to use post-mortem computed tomography (PMCT) as a supplementary method. However, low tissue resolution and limitations in imaging of soft tissues makes it impossible to use PMCT as the only research method. The purpose of this publication is to present typical injuries resulting from CPR, determine their frequency and contributing factors as well as the possibility of using PMCT to display them.

Keywords:

CPR, chest injury, post-mortem computed tomography, PMCT, rib fracture

Introduction

Cardiopulmonary resuscitation is a set of rescue operations which aims to restore the flow of oxygenated blood to the brain and the heart of an injured person who has had a sudden cardiac arrest[1]. The basic resuscitation procedure was developed in the 1960s and its core has remained unchanged[2]. According to the American Heart Association (AHA) 2015 guidelines, the effectiveness of resuscitation is ensured by executing 30 chest compressions with a frequency of 120/min and maximum depth of 6 cm[3]. This procedure carries the risk of a number of injuries, from minor subcutaneous haemorrhages of the chest, to a life-threatening heart wall rupture [4]. The fractures of the ribs and sternum are the most common complications of chest compressions in cardiopulmonary resuscitation[5]. In addition, damage to internal organs such as the heart, lungs or liver may occur, leading to pericardial, pleural or peritoneal hematoma[6,7]. The presence of this type of injury can significantly hinder the determination of the cause of death. To determine it with greater accuracy it is possible to use post-mortem computed tomography (PMCT) as a complementary method to the autopsy. For many decades, the autopsy was the basic tool in the hands of a forensic medicine specialist, however, at the beginning of the 21st century, a noticeable

decrease in the number of autopsies was observed. A 2002 study showed that the autopsy rate in the United States dropped from 40-50% to 6% in 20 years, which is consistent with global trends, also observed in Australia, France, Sweden and the United Kingdom[8,9]. At the same time, the role of PMCT as an alternative or complementary method in the post mortem examination began to grow significantly[10]. The advantages of PMCT include fast and accurate imaging of skeletal injuries, gas spaces such as air embolism or pneumothorax and extravasations of blood in the form of pericardial haemorrhage or pleural effusions[11]. The use of PMCT in the event of injuries after cardiopulmonary resuscitation can significantly contribute to their effective differentiation with other injuries or post-mortem lesions. The aim of this publication is to present typical injuries resulting from cardiopulmonary resuscitation, determine their frequency and contributing factors, as well as the possibility of using PMCT to display them.

Post Mortem Computed Tomography (PMCT)

The basic principle of computed tomography is the use of X-rays. After exposure of the tissue to this radiation, its absorption coefficient is calculated, depending on the density of a given tissue and differentiating it from the surrounding matter. The examined body is exposed to a beam of radiation whose source moves around the imaged object. Absorption coefficients of a given tissue are collected by detectors and expressed in Hounsfield units, the value of which is characterized individually in various types of tissues and body fluids[12]. The technique used for post mortem research is multi-detector computed tomography. The body should be placed on the table face up. If the change in its position is not required, it may remain in a sealed, specially designed bag and scanned entirely. The thickness of the scanning layers should be less than 2mm. This value depends on the spatial resolution of the image, the quality of multifaceted reconstruction and the size of the image data file in the DICOM format, which is later subjected to analysis. Depending on the needs during data processing it is possible to obtain 2D, 3D reconstruction and anatomical position of the imaged structures[13,14,15].

Skeletal injuries

Fractures of the ribs and sternum are the most common injuries resulting from cardiopulmonary resuscitation. In one of the first studies Hoke showed the presence of rib fractures in 13-97% of cases and fractures of the sternum in 1-43% of cases[16]. However, thanks to the latest research, these values were significantly narrowed. In a study conducted in South Korea, the frequency of rib fractures was determined to be 65% and the sternum was 30% [5]. The results of other researches coincide with these values. According to Dunham, rib fractures occur in 85% and sternum in 31%[17]. Similarly, in the Swiss study, percentages total to 90% for rib fractures and 60% for sternal fractures, respectively[18]. In contrast, in the Japanese study, the incidence of fractures in the sternum turned out to be lower than in the other studies (10%) while the incidence of rib fractures was coherent with the other studies (70%)[19]. The most common location of the rib fractures is the mid-clavicular line, the second one is the parasternal line and the third one axillary line[5,7]. This may result from the construction of the lower part of the front of the thorax (rib arc), which is composed predominantly of cartilage characterized by different physical properties than bones[6].

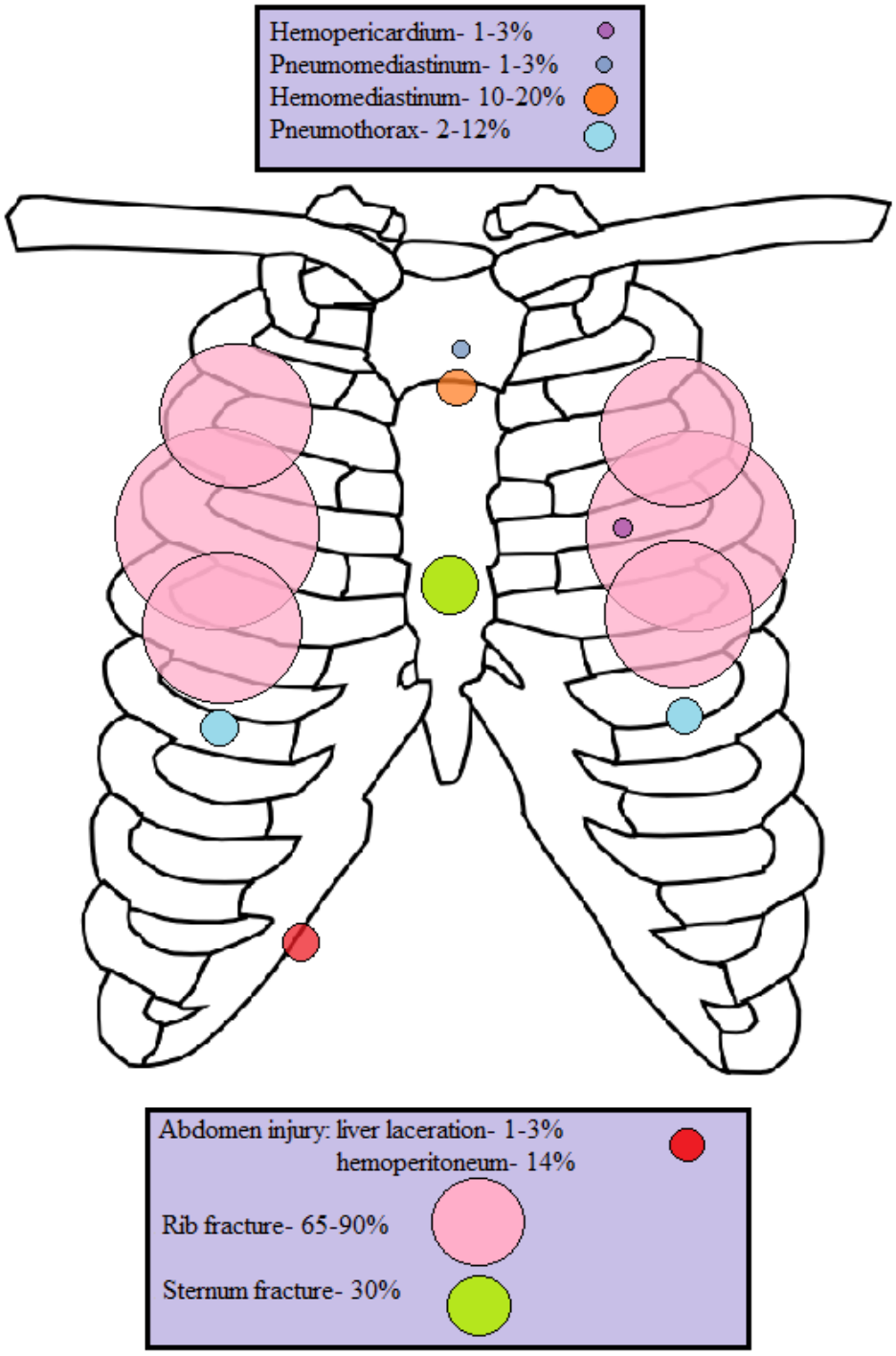

Figure 1. CPR related injuries
Source: Author's own drawing

Numerous rib fractures (> 7) are much more common, the percentage equals up to 76%, while single fractures occur only in 15%[17,19]. The group of multiple fractures is dominated by bilateral fractures (69%) of ribs over one-sided fractures (30%)[5]. In the image PMCT rib fractures can be classified based on the degree of discontinuity of the bone structure. Complete fracture is characterized by a complete disruption of both the cortical bone and the periosteum. It may be

accompanied by the displacement of broken rib fragments[17]. An incomplete fracture involves only one cortical layer. Depending on the damaged side, it may be an incomplete external or internal fracture. A subtype of incomplete internal fracture can be differentiated- the so-called buckle fracture. It occurs when the external cortical layer remains unchanged, while in the opposite cortical layer there is an incomplete fracture. The cortex undergoes an unnatural bending or curvature without clearly disrupting its continuity. Buckle rib fracture arises typically as a result of the strong chest compressions that are used in over the course of cardiopulmonary resuscitation[6,11]. Incomplete fractures occur more often, constituting up to 74% of all fractures according to American studies and 65% according to Australian studies, 40% of which are buckle fractures. In the group of complete fractures, fractures without dislocation occur more frequently (61% of total fractures) than fractures with dislocation (39% of total fractures)[6,11,17]. The most frequent location of the sternum fractures is the level of the third intercostal space (the area between the second and fourth ribs). Transverse fracture of the sternum occurred more often than diagonal fracture[5]. Transverse fracture is particularly difficult to detect, because it is best seen in the sagittal or coronary plane, which is not always possible to assess in the PMCT, which may be the reason for understating the actual number of fractures of the sternum after resuscitation[19].

Organ and soft tissue injury

Broken ribs and sternum can lead to life-threatening conditions, causing numerous soft tissue injuries. Most often, according to the American study, a mediastinal hematoma (in 10-20% of the injured) and pneumothorax (in 2-12% of the injured) occurs[19]. In about 1% pleural hematoma, pericardial hemorrhage and retrosternal hemorrhage in the mediastinum occurs as a result of damage to adjacent bone structures[19,21]. All the above lesions are clearly visualized with PMCT. In the PMCT image, subcutaneous or mediastinal emphysema resulting from the use of chest compressions may also be visualized[20]. The organs most commonly damaged by resuscitation are the liver and spleen. Rupture of the liver occurs in about 1-3% of cases and is a frequent organ complication after resuscitation within the abdominal cavity[7]. However, the complication that most often occurs in the abdominal cavity is bleeding in the peritoneum recorded in 14% of cases[22]. Less common complications include gastric perforation, rupture of the heart wall and pericardium wall or damage to the intestines[2,7]. However, the diagnosis of contusion or superficial injury to organs and soft tissue as well as rupture of vessels and organs basing on the PMCT image poses significant difficulties. The difficulties are caused by low tissue resolution and low sensitivity and specificity of PMCT in soft tissue imaging[21]. PMCT is a method characterized by high accuracy in imaging gas spaces. As a result of resuscitation, air embolisms may appear in the ventricles of the heart (especially right) or large vessels such as the portal vessels, the vena cava, subclavian, brachiocephalic and hepatic veins. During resuscitation due to chest compressions, venous cannulation and damage to the pulmonary parenchyma there is an inflow of air to these vessels and its retrograde distribution (to the brain or liver, among others). In the case of ineffective resuscitation, the correct venous inflow towards the heart is not restored and the intravascular air is not discharged, which facilitates the assessment of the PMCT image. In this case, the presence of gas in the portal and hepatic vessels in the PMCT image is significantly different from the changes resulting from the decomposition, which may take the form of putrefactive gas reservoirs[23]. During resuscitation using a bag valve mask or an oropharyngeal tube without

intubation (or if the tracheal tube is positioned incorrectly) the patient's intestines may develop ectasia, which is clearly depicted by PMCT. The image of intestinal ectasia resulting from resuscitation procedures is as characteristic as the image of the air in the network of liver vessels and its relation to the previously performed resuscitation has been proven. However, in this case, the PMCT image of decomposition processes and septic gases that form gas spaces should be taken into account as well[23].

Factors influencing the occurrence of injuries in the course of resuscitation

Advanced age is the most important independent predisposing factor for fractures of the ribs and sternum after cardiopulmonary resuscitation. In the population of senior patients, the fractures of the ribs are more often numerous (fractures> 3 ribs). Female gender is a risk factor for sternal fractures as complications after resuscitation. The suggested cause of higher number of sternum injuries in the female population seems to be lower sternum mineral density in women than in men, susceptibility to osteoporosis and age-related changes in bone matter that reduce mechanical strength of the bone[24,3]. Statistical studies also indicate that the average age in the population of women who require the use of cardiopulmonary resuscitation is higher than in the population of men who require cardiopulmonary resuscitation[26]. According to studies, a lower risk of chest injuries occurs when resuscitation is conducted by an accidental, untrained person. This may result from improper technique- too sensitive compressions with insufficient depth or too low frequency of the chest compressions. An important aspect is also the hesitation and fear of harming the injured person by an unqualified person, which reduces the effectiveness of the CPR activities that are carried out[3]. The duration of resuscitation is associated with the occurrence of complications. The longer the resuscitation procedures last, the greater the likelihood of injury or multiple injuries. The highest risk of injury was observed in cases of resuscitation that lasted above 60 minutes[4].

Conclusion

The knowledge of the complications that may occur during the course of cardiopulmonary resuscitation is extremely important during the forensic examination. Differentiation between primary injuries leading to death and secondary injuries resulting from resuscitation can be difficult, which makes it necessary to approach the challenge in a multidisciplinary matter, which is the use of post mortem imaging methods. The most common complications after resuscitation include rib fractures (65-90%) and sternum fractures(30%). The factors predisposing to their occurrence are: advanced age, female gender, unqualified person performing CPR and the long duration of the CPR. Disruption of the bone structure can be accurately visualized using PMCT, which allows for detection of more fractures than autopsy. In addition, PMCT allows not only to display the fracture itself, but also the injuries that occurred in adjacent tissues as a result. Such injuries include, among others, mediastinal hematoma, pneumothorax, pleural hematoma or retrosternal hemorrhage with hematoma and mediastinal hemorrhage. PMCT also differentiates abdominal injuries resulting from resuscitation, such as distention of the intestine and intestinal ectasia or accumulation of air in the hepatic portal circulation system from putrefactive changes occurring after death. However, low tissue resolution and limitations in imaging of soft tissues and organs makes it impossible to use PMCT as the only research method. PMCT complements the classic forensic examination.

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PROMOVENDI

Oferujemy:
- skład i łamanie tekstu,
- wydruk książek abstraktów
i monografii z numerem ISBN,
- oprawę graficzną wydruków,
- organizację konferencji,
- pomoc w organizacji konferencji,
- obsługę informatyczną
i administracyjną konferencji.