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ANALYSIS OF TIRE TYPES AND TREAD DEPTH IN VEHICLES OF M1 AND N1 CATEGORIES OPERATED IN THE SUMMERTIME IN ŠIAULIAI

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Annotation

From the point of view of traffic safety, tires are one of the most important parts of cars. Their wear or choosing the wrong tires quite often becomes the cause of an unfortunate traffic accident. It is especially important to pay attention to the use of the right tires for truck and passenger car drivers, because the car has contact with the road surface only on four surfaces of the human palm. Road traffic safety depends on activities in various areas: education of drivers and other road users, road quality and technical condition of cars. Tires are one of the components of a car. This paper examines grip coefficient characteristics, tire tread patterns and types to determine the condition and types of tires in use.

Key words: *tire types, tread depth, braking efficiency, adhesion coefficient.*

Introduction

In order to improve road traffic safety, it is necessary to undertake activities in various areas: educating drivers and other road users, improving the quality of roads and ensuring good technical condition of cars. Tires are one of the components of a car. More than a century after the creation of the first pneumatic (air-filled) tire, it is time to appreciate the benefits of this discovery. After a closer analysis of the development of the tire, we notice that there have been no very significant external structural changes, only the production technology itself and the properties of the materials used have changed. Despite this, the performance characteristics of the tires in terms of adhesion coefficient, driving speed and noise have changed radically. Not only the tires were changed, but also the vehicle. In order to ensure traffic safety, cars are equipped with various systems that help the driver in emergency situations: anti-lock brake system, traction control system, electronic stability system. However, none of the mentioned systems will be able to function properly when cars are operated with improperly selected or worn tires. The interaction of car tires with the road surface has a significant impact on traffic safety, which encourages the improvement of both car tires and the operational parameters of car roads.

Wheels with tires are of decisive importance for the car, because they are an elastic support that provides the car with engine traction and braking power, enables the car to change its direction of travel, and prevents the car from sliding under the influence of centrifugal forces. In case of adverse weather conditions, i.e. with a large amount of water on the road surface, insufficient depth of the tire tread pattern significantly reduces the adhesion of the car tires to the road surface. A wedge of water intervenes between the car tire and the road surface. This phenomenon is called aquaplaning. Therefore, the purpose of determining the minimum tread depth is to prevent accidents that occur in conditions that reduce road grip. The depth of the tread pattern must be such that it guarantees sufficient grip on the road, even in the worst conditions. Since 1989 June 1 EU approved requirement that minimum tread depth be 1,6 mm.

The performance of the tire is also greatly influenced by the parameters of the road. The surface structure of the potash coating determines driving comfort, rolling resistance, braking properties, and the noise produced by car tires. The road is an inseparable second part of the system (tire - road surface), on which all the properties of the system depend, so it must be considered in a complex manner.

It is very important to ensure that the cars are operated with tires whose grip properties match the weather conditions, i.e. summer tires would be used in summer and winter tires in winter. In order to find out what kind of tires are used by the drivers of cars operating in Šiauliai, a study was conducted evaluating the use of different types of tires during the summer period.

The aim of the research:

To study the types of car tires used in the summer and the depth of the tread pattern.

Research tasks:

1. Determine what types of tires are used on cars in the summer period;
2. Determine the depth of the tread pattern of are used car tires.

Methodology of investigation

After the mandatory use of winter tires was introduced in Lithuania from November 10. until April 1, some drivers drive cars with winter tires even in the warm season. It is known that a car with winter tires does not brake as effectively as a car with summer tires in the warm season. The task of the study was to investigate how many cars drive with winter tires in the warm season. To implement the task, three parking lots near shopping centers in Šiauliai were chosen, where cars are not left for longer periods of time. This assumes that the cars analysed are in continuous operation. The check of the condition and types of car tires was carried out near the shopping centers "Bruklinas", "Tilžė" and the store "Maxima" located at Rudės street 14. The map of places for checking the condition of tires is shown in Figure 1.

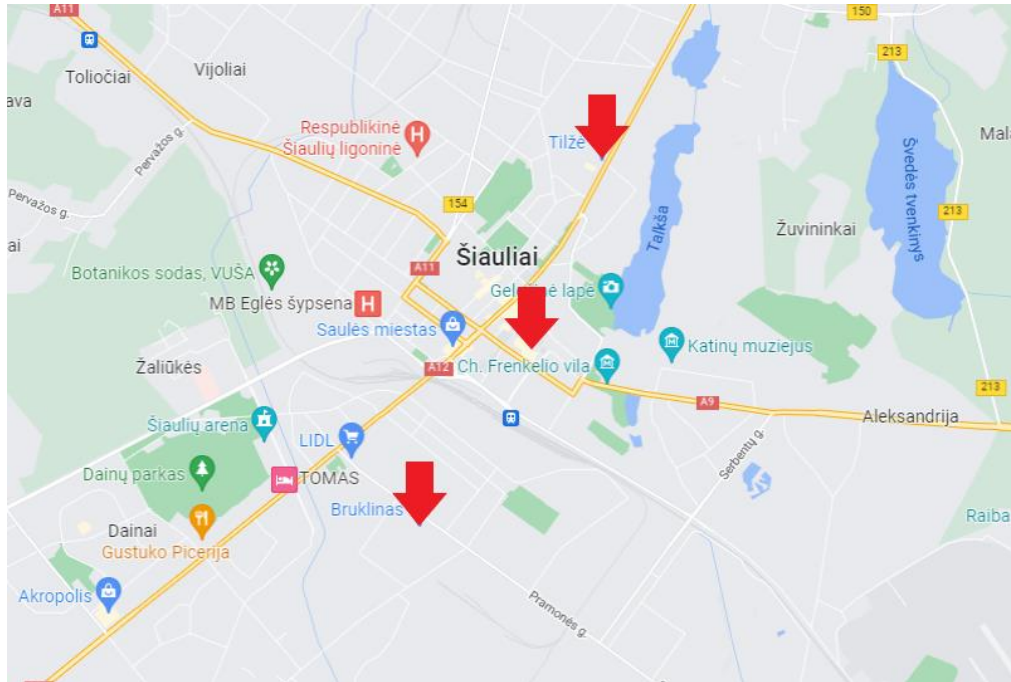


Fig. 1. Tire condition inspection locations in Šiauliai

During the investigation, car tires were inspected and their type was determined based on the tread pattern and markings. In the tread pattern, tire manufacturers insert a tire wear indicator (Figure 2). The tread wear indicator is a narrow raised mark located across the longitudinal grooves of the tire's tread pattern.



Fig. 2. Tire tread depth wear indicators

To make it easier to find tread depth indicators, tire manufacturers print the letters TWI (Tread Wear Indicator) on the side of the tire. If the tread depth is reduced to 1,6 mm, the height of the tread and its wear mark are at the same level. Such a tire is considered no longer suitable for use (unsafe). During the winter period, from November 10 to April 1, cars must be operated

with winter or universal tires, the tread depth of which cannot be less than 3,0 mm. The tread depth of the tested tires is measured in three places: in the middle of the tire and on both sides (Figure 3).



Fig. 3. Tire tread depth measurement

The research to determine the types of tires used and the depth of the tread was carried out in August 2022. In Lithuania, it is the summer period.

Analysis of theoretical aspects of tire adhesion to the road surface

A tire is one of the car's elements, on which traffic safety, fuel consumption, and passenger comfort depend. The adhesion coefficient is the main parameter for predicting the car's behaviour during braking and other emergency situations and for designing active safety systems. The contact properties of the road surface and tires determine the driver's behaviour in an emergency situation and the consequences [1].

Longitudinal traction is the ability of a car tire to transmit longitudinal traction or braking force in the area of the contact patch to the rolling surface. When the driving wheel tire transmits a longitudinal force to the contact surface during rolling, a shift occurs between the tire and the road contact, i.e. kinematic distances. The linear speed of the outer part of the driving wheel at the point of contact with the road during traction is higher than the speed of the center of gravity of the car itself. This phenomenon is called relative slip and is denoted by s . Slip in the longitudinal direction s_L (%) is calculated [5]:

$$s_L = [(V_R - V_o) / V_o] \cdot 100 \% ; \quad (1)$$

here: V_R - speed of the outer part of the driving wheel, m/s; V_o - speed of the car, m/s.

or:

$$s_L = [(S_R / S_o) - 1] \cdot 100 \% ; \quad (2)$$

here: S_R – displacement of the wheel periphery, m; S_o – distance, m.

The greater the force exerted by the tire on the road surface, or the lower the sliding friction coefficient of the road surface, the greater the slippage. Although the tire slips relatively, there is friction between it and the road surface, which is characterized by the coefficient of adhesion μ_k :

$$\mu_k = F_L / F_R ; \quad (3)$$

here: F_L – longitudinal force, F_R – normal load.

The adhesion coefficient is defined as the ratio of the longitudinal force of wheel traction acting on the road surface and the normal load pressing on the wheel.

The adhesion of a tire to the road surface is one of the main indicators of its efficiency, which affects traffic safety. By improving tire designs, materials that allow improving the main indicators of tire adhesion to the road surface (adhesion and sliding friction coefficients), new tread patterns, special tread rubber compounds have been created. Which significantly improve tire grip on wet and slippery road surfaces, tire elasticity at low ambient temperatures (-8 °C and below) [3]. Improvements in the design of cars (anti-locking and traction control systems, active and semi-active suspension systems, etc.) affect the interaction of the car wheel with the road.

The road surface (materials, texture, technical condition, meteorological conditions - water, snow, ice) has a no less influence than the tire on the optimality and stability of the parameters of the connection road - tire.

One of the main indicators of tire adhesion to the road surface is tread slippage. The values of the adhesion coefficient depend on the longitudinal slip. On a dry road, with a wheel slip of about 14 %, the grip is the highest and its value reaches $\mu_k = 0,99$. On a wet road, the μ_k value decreases by about 20 %, on a snow-covered road - by about 60 % ($\mu_k \approx 0,40$) and on an ice-covered road - by about 82 % ($\mu_k \approx 0,18$). As tire slippage increases, the efficiency of its tread grip with the road surface decreases. When the slip reaches the critical limit, that is 100 %, the longitudinal contact force acting on the area of contact of the tire with the road will become equal to the frictional force between the tread and the road surface. This happens when braking the car with locked wheels or when moving with spinning wheels. In this case, the adhesion coefficient is immediately reduced by 20...35 %. The values of the coefficient of adhesion and the coefficient of sliding friction are equal: $\mu_k = \mu_l$ [4]. Under this condition, the car practically becomes out of control (emergency situation).

The parts of the tire include the distribution of materials in terms of cross-section and the thickness of the tread and grooves. The tire consists of five rubber elements (tread, lower tread, shoulder wedge, sidewall and bead filler) and five reinforcing straps [2]. The distribution of rubber components in half the cross-section is presented in Figure 4. Temperature and load have the greatest influence on rolling resistance, while speed and tire inflation pressure have little influence on rolling resistance.

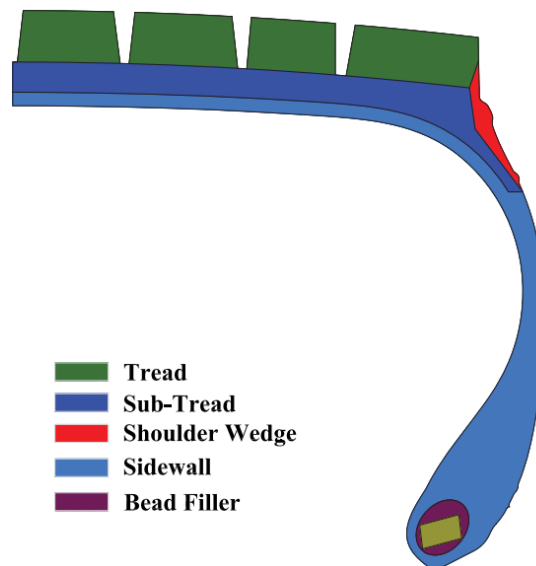


Fig. 4. Distribution of material properties in tire's half cross section. [2]

Tire-wet-road friction depends heavily on tread depth, speed, and water depth. The car owner-operator has control over speed and tire condition, but not on water depth or road surface texture. While wet-road speed conditions are not legislated, minimum tire tread depth generally is codified. The easiest and safest response to wet road conditions is to reduce speed, usually below posted speeds, which are set for dry conditions. Common experience indicates this does not happen routinely, except in very heavy downpours. Speeds should be reduced to below 90 km/h, even for minimally wet roads, to prevent significant loss of friction.

The research also shows that the common legislated value of minimum tread depth (1,6 mm) is not a sufficient depth to prevent a substantial loss of friction on even minimally wet roads at highway speeds. A doubling of this legal minimum, to approximately 3 mm, is recommended and is supported by other researchers. Both the EU and the UK have adopted a minimum legal tread depth standard of 1.6 mm. Recent research has indicated a substantial loss of friction on minimally-wet roadways, at highway speeds, when tire-tread depth falls below 3,0 mm [5].

The European Commission classifies vehicles as part of emission standards and other vehicle regulations. Passenger cars receive an "M" categorization, while commercial vehicles receive an "N" categorization. Two directives of the European Parliament and of the Council serve as sources for these definitions and classifications: 2002/24/EC of 18 March 2002 and 2007/46/EC of 5 September 2007. In addition, the EU legislation on driving licenses (Directive 2006/126/EC of 20 December 2006) provides for a splitting of some categories of vehicles [6].

Category M – Motor vehicles having at least four wheels and for the carriage of passengers. Category M1 – Vehicles designed and constructed for the carriage of passengers

and comprising no more than eight seats in addition to the driver's seat, and having a maximum mass ("technically permissible maximum laden mass") not exceeding 3,5 tons. Category N – Power-driven vehicles having at least four wheels and for the carriage of goods. Category N1 – Vehicles designed and constructed for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat, and having a maximum mass ("technically permissible maximum laden mass") not exceeding 3,5 tons. [7].

Tires are the only part of the car that is in direct contact with the road, therefore, they must be suitable and of good quality. They provide adequate grip with the road surface, thanks to which the car is easy to control, accelerate or brake when necessary. Tires can be of different types (Figure 5), intended for different seasons, with different tread depth and pattern.



Fig. 5. Types of tire treads [8]

Summer tires have a dedicated rubber compound that delivers excellent grip and handling on both dry and wet roads in warmer conditions. They also have reduced rolling resistance and therefore provide greater fuel efficiency and generate less road noise. The tread pattern on a summer tire is more streamlined than a winter tire, with fewer grooves for water clearance, maximizing the contact patch with the road. Consequently, the vehicle has superior traction and braking during dry summer months. However, these same characteristics – the unique rubber compound and simple tread design – make summer tires unsuitable for winter driving conditions. When the temperature drops below 7 degrees Celsius, the compound becomes hard and brittle, and the tread design can't adequately handle snow or ice.

Winter tires provide outstanding grip on road surfaces covered with snow and ice, as well as wet roads in cold conditions. The tread compound of a winter tire contains more natural rubber, so it doesn't harden when the temperature drops below 7 degrees Celsius. Instead, it stays flexible and limber in cold climates to reduce the stopping distance when braking. The tread design has deeper blocks that will dig into snow and ice to provide more grip. The winter tire also has a lot of sipes, which are excellent for clearing water and slush from the path of the car and mitigating the risk of hydroplaning. Winter tires shouldn't be used for the summer season, however. The compound is far too soft for dry asphalt, meaning it will wear out quicker. Moreover, the increased rolling resistance will lead to higher fuel consumption and road buzz [9].

During the summer, winter tires should be changed to summer or universal tires, because: 1. Winter tires are made for a lower temperature range than all-season or summer tires. Many drivers think that they can save money by riding their winter wheels all year round. Unfortunately, this is completely wrong. All tires start life with differently engineered rubber compounds, each designed for specific temperature ranges. Compared to summer compound tires, which have a lot of smooth tire blocks for maximum surface area grip, winters have a lot more sipes and softer compound tread blocks. These flexible heavily siped blocks are designed for gripping onto uneven snowy or icy surfaces and not for consistently dry and warm pavement. 2. Your winter tires will wear much faster above 7 degrees Celsius. As the aforementioned sipes and tread blocks come into contact with the dry and warmer spring pavement, heat is created as the rubber blocks are compressed. Because the sipes rapidly open and close as they come into contact with the dry pavement with no snow or ice to cool them down. And too much heat is the worst enemy of a tire. 3. You will not be able to stop your car as quickly. By design, compared to a good all-season tire, a winter tire will have 2-3 times as many tread blocks. On dry and warm pavement though, this flexible-by-design construction can make stopping distances significantly longer (Figure 6).

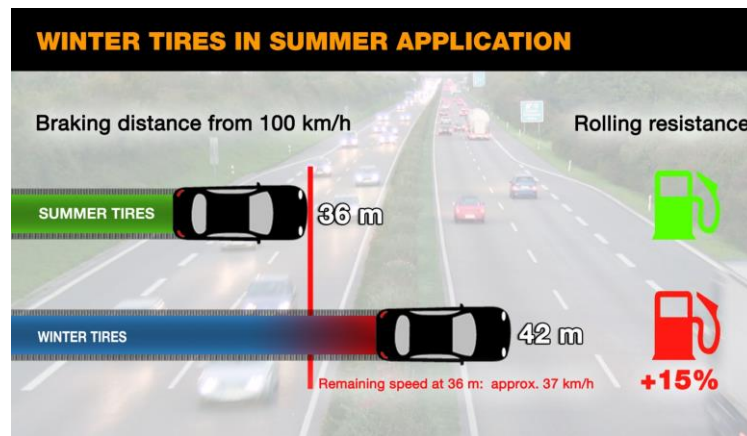


Fig. 6. The difference in stopping distance with winter tires in summer application [10]

At over 30 degrees Celsius, the winter tires' rubber will start to marble. A dangerous situation as little rubber balls are formed and will spin under the wheel. Study's found that winter tire equipped cars (in spring/summer conditions) needed one-and-half to two car lengths more stopping distance. The hotter the ambient temperature, the longer the stopping distance. A potentially dangerous scenario. A winter/summer tire comparison study done by Continental Tires found that there is around 15 per cent less steering precision when using winter tires during warm spring/summer temperatures. The same study found that in summer conditions, winter tires reached their critical limits below 70 km/hr during an avoidance maneuver. By contrast, the same maneuver is unproblematic even at 80 km/hr when equipped with summer tires. Due to the softer and stickier rubber compound, winter tires have a much higher rolling resistance. Rolling resistance is defined as the energy that is lost when the tire is rolling. The main reason for loss of energy is the constant deformation of the tire. The level of wear on winter tires is high at warm times of the year and the rolling resistance is 15% higher than that of summer tires [10].

Research results and their analysis

During the research, car tires were inspected and their type was determined, and their tread depth was measured. Tire inspection took place in 2022. in August in Šiauliai. During the entire investigation, 603 cars were checked. During the research, 352 cars were found operating with the best tires for this season, which is 58,4% of all cars checked. The rest (41,6%) of cars in use are not properly adapted to the operating conditions of the season. Of these, 182 cars were found with winter tires, which is 30,2% of all cars checked. The drivers of 41 tested cars chose to use universal, that is, tires adapted to all seasons. Cars operated with universal tires accounted for 6,8% of all inspected vehicles. During the research, a small part (4,6%) of such cars were also found, which were also operated with different types of tires (Fig. 7).

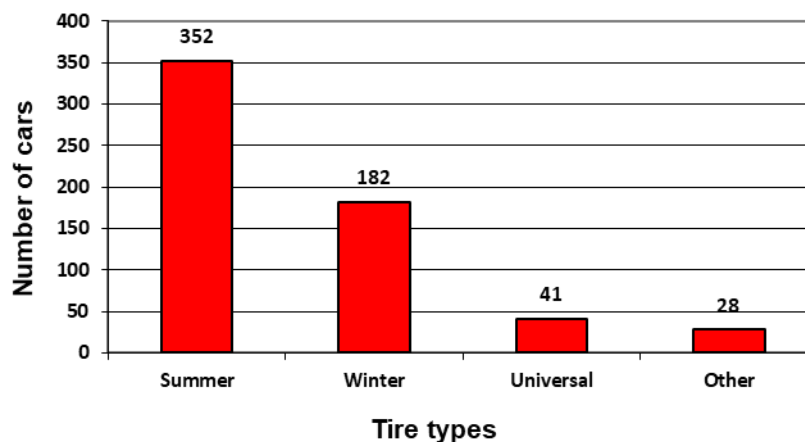


Fig. 7. The results of checking the types of tires of cars in use in Šiauliai

As already mentioned before, during the research, not only the type of tires used was determined, but also the depth of the tread pattern was measured. It was found that only two

cars were found to have exceeded the permitted level of tire tread wear by up to 1,6 mm. We know from the traffic rules that it is forbidden to operate cars with a tire tread depth of less than 1,6 mm. During the investigation, 64 cars with summer tires were found, the tread depth of which was less than 3,0 mm but still allowed for operation. There were 18,2% of such cars with insufficient tire tread depth from the point of view of traffic safety. The other cars tested with summer tires were with good tread depth and scored 81,3 percent (Figure 8).

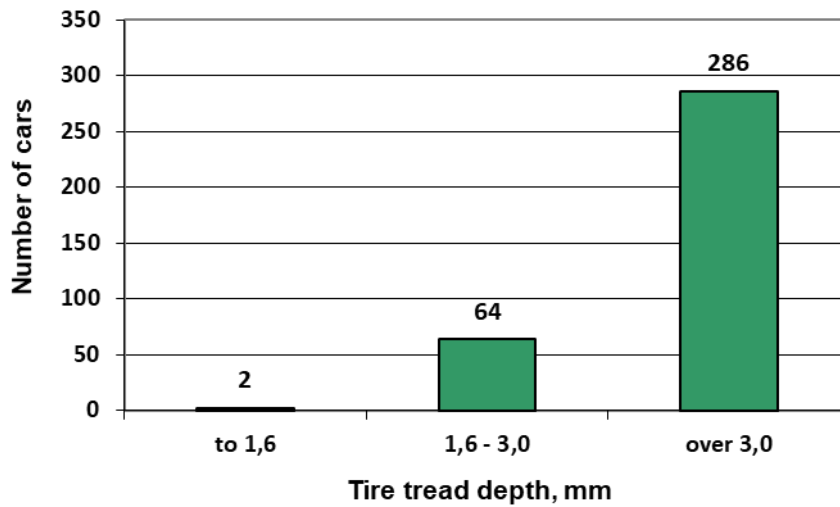


Fig. 8. The results of the study of the tread depth of summer tires

The depth of the tread pattern of cars operated with winter tires was also studied. No tires with a tread pattern depth of less than 1,6 mm were found (Figure 9). Such tires cannot be used in summer. Of the cars operated with winter tires, 68 of them were used with a tire tread depth of less than 3,0 mm. There were 37,4% of such cars. As we know from the traffic rules, it is forbidden to operate cars with a tire tread depth of less than 3,0 mm from November 10 to April 1, i.e. during the winter period. But nothing forbids the use of such tires in the summer. Other cars with winter tires had a tread depth greater than 3,0 mm and these cars can still be operated in the winter period. The question arises why drivers use such tires in the summer time.

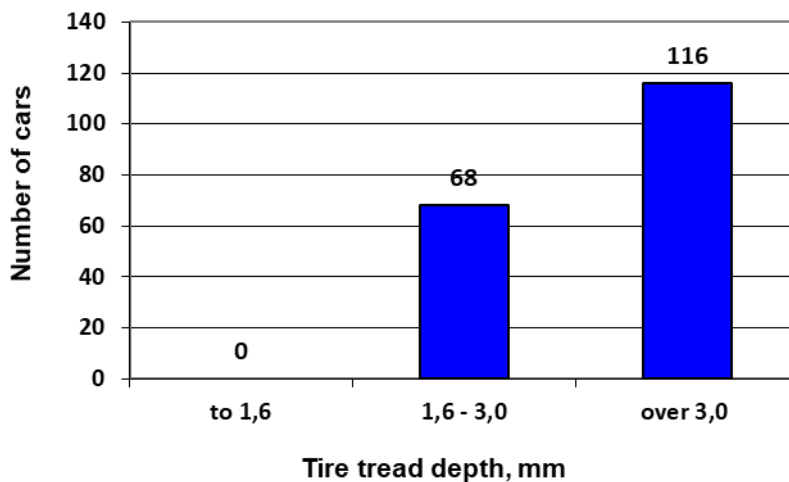


Fig. 9. Results of winter tire tread depth research

When checking the types of tires in use, 41 cars with universal tires were found. Tires with a tread pattern depth of less than 1,6 mm were also not found, as in the case of winter tires (Figure 10). Of the cars operated with universal tires, 22 of them were used with tire tread depth less than 3,0 mm. There were 53,6% of such cars. As we know from the traffic rules, cars with a tire tread depth of less than 3,0 mm are prohibited to operate in the winter period. But nothing forbids the use of such tires in the summer. Other cars (46,4%) with universal tires had a tread pattern depth greater than 3,0 mm and these cars can still be operated in the winter period.

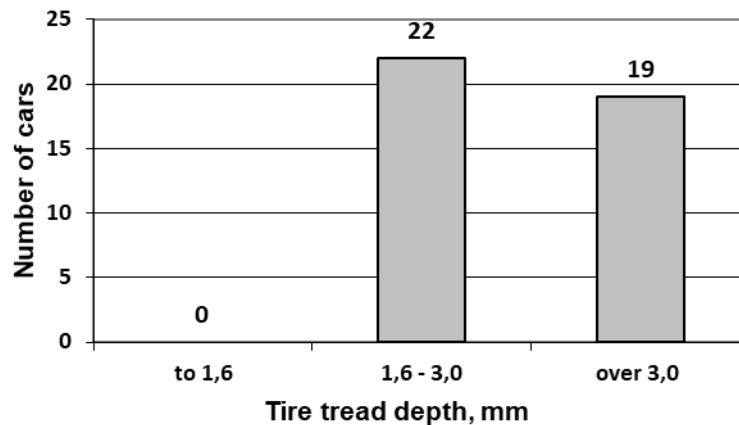


Fig. 10. The results of the study of the tread depth of universal tires

In total, only 0,4% of cars were detected with unsuitable tires during the summer period. 154 types of non-rated tires with a tread depth between 1,6 mm and 3,0 mm were found on cars, which is 25,5% of all cars checked. This tread depth is considered permissible, but not recommended by transport safety specialists. 74,1% of the checked cars have good tires with a tread depth of more than 3,0 mm.

During the study of the types of tires used in the summer period, it was noticed that older cars were mostly recorded with winter tires. It can be assumed that their owners have a lower income and are not always inclined to change tires with the change of seasons. In the case of inflation, the prices of the tires themselves and the prices of service services also rise. More frugal drivers tend to use winter tires whose tread depth will no longer be suitable for the winter season to "drive" in the summer. This is not acceptable from the point of view of driver safety.

During the study of the types of tires used in the summer period, it was noticed that older cars were mostly recorded with winter tires. It can be assumed that their owners have a lower income and are not always inclined to change tires with the change of seasons. In the case of inflation, the prices of the tires themselves and the prices of service services also rise. More frugal drivers tend to "kill" winter tires whose tread depth will no longer be suitable for the winter season in the summer. This is not acceptable from the point of view of driver safety.

Conclusions

The technical condition of car tires operated in Šiauliai is not bad. Only 0,33% of all cars tested were found to be operating with tires with the wrong tread depth (less than 1,6mm). During the investigation, 603 cars were checked. Quite a large part of the cars operated in Šiauliai (25,9%) use tires with a tread depth of less than 3 millimeters. Tires worn to this level are no longer recommended for wet conditions. During the investigation, the behaviour of drivers was found to be unacceptable as a sign of traffic safety. Drivers operate summer cars with winter tires. Cars with winter tires were found in 182 out of 603 checked cars. This is 30,2 percent of all inspected cars. It has been noticed that cars operated with winter tires are usually quite old. Drivers of such cars are likely to have lower incomes and are not always inclined to change tires with the changing seasons. In the case of inflation, the prices of tires and service services also rise. Another possible reason for drivers behaving like this was the reluctance to visit car repair shops during the containment of the COVID-19 pandemic. More frugal drivers prefer winter tires, whose tread depth (less than 3,0 mm) will no longer be suitable for the winter season to "kill" in the summer time.

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CONFIGURATIONS OF ENGLISH THREE AND FOUR WORD ANATOMICAL TERMS AND THEIR LATIN EQUIVALENTS IN THE TEXTBOOK *HUMAN ANATOMY (VOL. II)*

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Annotation

The extensive borrowing of words from Latin and Greek into English that began about 1500 AD continued for hundreds of years and continues to this day.

The article analyses the variety of grammatical configurations of English and Latin multi-word anatomical terms, their frequency, identity and differences in grammatical configurations. The textbook on human anatomy by M. Prives, V. Bushkovich, N. Lisenkov under the general editorship of prof. M. Prives reflects the data on anatomical science and offers a number of advantages over other textbook. Human Anatomy offers a progressive view descriptive, evolutionary, functional, and practical anatomy.

Key words: *adaequate terms, gramatical configurations, different anatomical terms, compound anatomical terms.*

Introduction

The science of human anatomy is the study of the form and structure of the human body (and the organs and systems which form it) and the regularities of the development of this structure in relation to its functions and external environment. Anatomy started forming as a science under the ancient Greeks. One of the eminent physicians of ancient Greece, Hippocrates (400-377B.C.) believed that four "humours" formed the basis of the structure of the organism: blood (sanguis), phlegm (phlegma), yellow bile (chole), and black bile (melas chole) (Prives et al., 1985, 15-19).

Medical terminology may be divided into two main parts: anatomical (based on Latin) and clinical (based on Greek). The modern anatomical terminology is based on the centuries-old tradition and knowledge that is constantly revised. Clinical medicine has not finished its development yet and there are many questions for it to answer regarding the aetiology of the existing diseases as well as new ones. The names of diseases were formed empirically in various times and places therefore clinical terminology is not so uniform. Besides, clinical subjects continue to develop, so their knowledge must be continually revised. While Latin dominates in medical records and communication among doctors, English is mostly used in doctor-patient communication and as a language of international cooperation. Therefore, medical English is taught with reference to Latin. We see advantages in the parallel teaching of Latin and English in the first year of study at our faculty because students can easily combine their knowledge, compare differences in word formation and adapt terminology of English speaking professionals. Medical terminology based on Latin and Greek has several advantages: it provides continuity between the past and the present as well as continuity in space – Latin terminology is used all over the world; the grammatical system and vocabulary of Latin and Greek does not change, therefore modern terms are still based on these dead languages; it has a practical importance in Medicine – the patient does not understand it and cannot draw adequate conclusions (Bujalková, 2018).

With the Renaissance (1400-1600 AD) came a revival of classic scholarship. English words began to be formed directly from Latin and Greek and were no longer borrowed through the intermediary of French. Beginning about 1500 AD, for the first time the writings of the ancient Greeks were read in England in their original language. Words were borrowed extensively from Greek and Latin, both with and without change, and new words were created that combined both Latin and Greek elements. The English of this period is now known as Modern English.

Since the 20th century, English has dominated in Science. Research on the interference of Latin into English confirmed that 98% of all English medical terms have Latin or Greek roots,

as do new medical words which arise every month. However, Turmezei found out that 89% of English anatomical terminology is of Latin (65%) and Greek (24%) origin. This provides evidence that medical students cannot successfully accomplish their study, if they ignore the course in Medical Latin. It is difficult to argue that one can successfully learn anatomy, physiology, and many aspects of Medicine without a basic working knowledge of Latin. It is the contention of some experts that English will not utterly eclipse Latin, but that its origin as a Latin-derived language serves the role of promulgating Latin into the next era. In contrast, anatomical terms remain in their original form. Despite the tendency of English to be the new „lingua franca“ of medicine, English medical terminology is strongly rooted in Latin. In other words, medical English is latinized. The latest revision of anatomical nomenclature, „Terminologia Anatomica“(1998) is in Latin which serves as a basis for national versions including English language versions (Bujalková, 2018).

Throughout history, dominance in knowledge has had repercussions on language relationships. Since the second half of the 20th century, probably as a direct consequence of U.S. leadership in many technical fields, English has become the lingua franca for medical research, and English terms have been imported into many other languages. Even though the advantages of a common language of research are obvious, the predominance of English places native speakers at a competitive advantage over those who first have to acquire sufficient linguistic skills to communicate their ideas and findings in a language foreign to them or to read English material. For medical translators, of course, this is good news (Berghammer, 2006).

The extensive borrowing of words from Latin and Greek into English that began about 1500 AD continued for hundreds of years and continues to this day. New advances were made in the field of Medicine and Science during and after the Renaissance (and continuing up to the present day) and words were needed to describe these new discoveries and inventions. Medical scientists turned to the early Greek and Roman physicians, especially Hippocrates, Galen and Celsius, and borrowed words from their medical treatises.

The article analyses the terminology of one of the fields of medical science – the anatomical terminology used in the textbook *Human Anatomy* (1985) by M. Prives¹, V. Bushkovich², N. Lisenkov³. The textbook consists of two volumes. Volume I includes: the weight-bearing and locomotor system, the science of the viscera, the science of the organs of internal secretion. Volume II includes: the science of the vessels, the science of the nervous system, the science of the sensory organs. At the end of both volumes there are subject indices.

The textbook on human anatomy by M. Prives, V. Bushkovich, N. Lisenkov under the general editorship of prof. M. Prives reflects the data on anatomical science and offers a number of advantages over other textbook. *Human Anatomy* offers a progressive view descriptive, evolutionary, functional, and practical anatomy. The textbook approaches the human organism both analytically, according to organs and systems, and synthetically, as a discrete unit with close ties to the environment, especially to society. The book also contains a discussion of the influence of social factors, including the influence of extreme social conditions, on the structure of the human organism and includes a section on new trends in anatomical science under investigations by Prives. The textbook also contains information on the study of X-ray anatomy, the anatomy of the living human being. The textbook is available both for the traditional view of anatomy as the science of the human body structure and for its presentation of anatomy as the science of the natural laws regulating the structure and development of the human organism in relation to the environment. Anatomy is thus seen not as the stagnant subject of university courses but as a progressive science with important prospects. The textbook has been published four times in Spanish for the use in Latin America (Prives et al., 1985).

The research object of this article is the English and Latin compound anatomical terms. The paper refrains from the analysis of one-word anatomical terms, as they make up only an insignificant part of anatomical terminology.

¹ Professor M. G. Prives with his colleagues conducted research into the anatomy of introorganic vessels and advanced the study of the effect of the nervous system on collateral circulation. They introduced various new trends in anatomical science: the study of the anatomy of persons of various occupations (the effect of various professions, sports (sport anatomy), and space travel (aviation-space anatomy) on the structure of the bone and vascular systems. M. G. Prives developed a method for preserving cadavers and individual parts of the body without the use of formaldehyde. The method produces dry specimens which need not be kept in solution and maintain their structure, natural colour, consistency, elasticity, and bulk for more than twenty five years.

² Professor V. I. Bushkovich was the co-author of the *Normal Human Anatomy* with the professor N. K. Lysenkov.

³ Professor N. K. Lysenkov was involved in all the main branches of anatomical study concerned with the normal structure of man: normal topographic and plastic anatomy. He wrote various manuals on these subjects, one of which *Normal Human Anatomy* has run into five editions.

Aims of the article. The comparative analysis of syntagmatic and paradigmatic relationships of compound anatomical terms in the aspects of coincidence and difference. To achieve that aim, the following objectives are set:

- To analyse the aspects of coincidence of English and Latin three-word and four-word anatomical terms and their structural groups.
- To examine the aspects of difference between English and Latin three-word and four-word anatomical terms and their structural groups.
- To identify the frequency and usage trends of structures of English and Latin compound anatomical terms.

Research material and methods. Using descriptive and comparative methods, one of the terminologies of the fields of medical science – the terminology of anatomy – is analysed. A descriptive analytical method was employed to perform quantitative (of English and Latin compound anatomical terms in general) and qualitative (of specific configurations) analyses.

ENGLISH AND LATIN THREE WORD ANATOMICAL TERMS

The three-word term can be expressed as follows:

$$f^4 (t_1 \dots t_n) = f (t_1 \dots t_n), \text{ when } n = 3$$

English three-word anatomical terms and their Latin equivalents form two more commonly used types of grammatical configurations (Litevkienė, 2006):

1. $Adj_{NC}^5 + Adj_{NP} + S_N \equiv S_N + Adj_{NP} + Adj_{NC}$
2. $Adj_{NP} + Adj_{NP} + S_N \equiv S_N + Adj_{NP} + Adj_{NP}$

One hundred and ninety four compound *English three-word terms* ↔ *Latin three-word terms* were found. According to English and Latin elements, the terms of this group can be divided into 9 configuration types:

Type 1

English CT ⁶	<i>agreed attribute+ agreed attribute+ determinative</i>
Latin CT	<i>determinative+ agreed attribute+ agreed attribute</i>

1. Nominative of a comparative (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) ≡ nominative of a noun (determinative) + nominative of an adjective (attribute) + nominative of a comparative (attribute):

$$Adj_{NC} + Adj_{NP} + S_N \equiv S_N + Adj_{NP} + Adj_{NC}$$

superior phrenic arteries – arteriae phrenicae superiors (HAI175)	inferior sternoclavicular ligament – ligamentum sternoclaviculare inferius (HAI1215)
inferior phrenic arteries – arteriae phrenicae inferiors (HAI182)	inferior gluteal artery – arteria glutea inferior (HAI185)
superior rectal artery – arterija rectalis superior (HAI181)	inferior epigastric artery – a. epigastrica inferior (HAI186)
superior gluteal artery – arteria glutea superior (HAI184)	superior thyroid veins – venae thyroideae superiores (HAI1104)
superior thyroid artery – arteria thyroidea superior (HAI155)	anterior sternoclavicular ligament – ligamentum sternoclaviculare anterius (HAI215)
posterior auricular artery – arteria auricularis posterior (HAI155)	anterior tibial artery – arteria tibialis anterior (HAI191)
posterior intercostal veins – venae intercostales posteriors (HAI1108)	posterior tibial artery – arteria tibialis posterior (HAI191)
inferior vena cava – vena cava inferior (HAI110)	anterior vertebral surface – facies vertebralis anterior (HAI1141)
superior mesenteric veins – venae mesentericae superior (HAI113)	inferior nasal concha – concha nasalis inferior (HAI1183)
inferior mesenteric veins – venae mesentericae inferior (HAI113)	posterior sacral foramina – foramina sacralia

⁴The author grounds on the theory Ross Moore, a mathematician of Macquarie University (Sydney) and Nika Draka, a programmer of Leeds University (England) about the construction of compound term computerized systems, symbols and the diversification of compound term systems.

⁵S – substantive; Adj– adjective; P – participle; N – numeral; N_o– ordinal, Pr – pronoun; N– nominative; G– genitive; s – simple; c– comparative; s– superlative; c– compound; m– mixed composition, p – positive

⁶Compound terms

superior frontal sulcus – sulcus frontalis posterior (HAI137)
 superior (HAI214) anterior sacral foramina – foramina sacralia
 anterior (HAI137)

According to the provisions of the PNA, the adjectives that function as secondary elements of compound anatomical terms, which denote the location of human body parts and organs and the quantitative properties of body parts and organs, are related by the relationship of the opposite, in other words, antithesis. After analysing the terms found in the source, it can be stated that there are a number of compound terms in the Latin anatomical terminology, the secondary element of which is a comparative adjective. Compound terms of this type occur in the systematics of arthrology and splanchnology (Litevkienė, 2006).

2. Nominative of an adjective (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) \equiv nominative of a noun (determinative) + nominative of an adjective (attribute) + nominative of an adjective (attribute):

$$\text{Adj}_{NP+} \text{Adj}_{NP} + \text{S}_N \equiv \text{S}_N + \text{Adj}_{NP} + \text{Adj}_{NP}$$

right colic artery – arteria iliaca communis (HAI184)	lateral thoracic vein – vena thoracica lateralis (HAI107)
middle colic artery – arteria iliaca media (HAI184)	internal mammary vein – vena thoracica interna (HAI108)
common iliac artery – arteria iliaca communis (HAI184)	right suprarenal vein – vena suprarenalis dextra (HAI111)
internal iliac artery – arteria iliaca interna (HAI184)	right lumbar vein – vena lumbalis dextra (HAI111)
lateral iliac artery – arteria iliaca lateralis (HAI184)	left lumbar vein – vena lumbalis sinistra (HAI111)
lateral sacral artery – arteria sacralis lateralis (HAI184)	external iliac artery – arteria iliaca externa (HAI186)

3. Genitive of a noun (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) \equiv nominative of a noun (determinative) + nominative of an adjective (attribute) + nominative of an adjective (attribute) (Litevkienė, 2014):

$$\text{Adj}_{NP+}^7 \text{Adj}_{NP} + \text{S}_N \equiv^8 \text{S}_N + \text{Adj}_{NP} + \text{Adj}_{NP}$$

ulnar colleteral artery – arteria collateralis ulnaris (HAI168)

4. Nominative of a comparative (attribute) + nominative of a participle (attribute) + nominative of a noun (attribute) \equiv nominative of a noun (determinative) + nominative of a participle (attribute) + nominative of a comparative (attribute):

$$\text{Adj}_{NC} + \text{P}_N + \text{S}_N \equiv \text{S}_N + \text{P}_N + \text{Adj}_{NC}$$

posterior communicating artery – arteria communicans posterior (HAI184)

5. Nominative of an adjective (attribute) + nominative of a participle (attribute) + nominative of a noun (attribute) \equiv nominative of a noun (determinative) + nominative of a participle (attribute) + nominative of an adjective (attribute):

$$\text{Adj}_{NC} + \text{P}_N + \text{S}_N \equiv \text{S}_N + \text{P}_N + \text{Adj}_{NC}$$

grey communicating branches – rami communicantes grisei (HAI331)

6. Nominative of an ordinal (attribute) + genitive of a noun (attribute) + nominative of a noun (attribute) \equiv nominative of a noun (determinative) + genitive of a noun (attribute) + nominative of an ordinal (attribute):

$$\text{N}_{OG} + \text{S}_G + \text{S}_N \equiv \text{S}_N + \text{S}_G + \text{N}_{OG}$$

fourth roof ventricle – tegmen ventriculi quarti (HAI198)

7. Nominative of a noun (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) \neq nominative of a noun (determinative) + nominative of a participle (attribute) + nominative of an adjective (attribute):

⁷S – substantive; Adj – adjective; P – participle; N – numeral; N_o – ordinal, Pr – pronoun; N – nominative; G – genitive; s – simple; c – comparative; s_s – superlative; c – compound; m – mixed composition, p – positive
⁸adequate

$Adj_{NP} + Adj_{NP} + S_N \neq^9 S_N + P_N + Adj_{NP}$
radial recurrent (adj) artery – arteria recurrens radialis (HAI168)

8. Nominative of a participle (attribute) + nominative of an adjective (attribute) + nominative of a noun (attribute) \neq nominative of a noun (determinative) + nominative of an adjective (attribute) + nominative of a participle (attribute):

$P_N + Adj_{NP} + S_N \neq S_N + Adj_{NP} + P_N$
ascending pharyngeal artery – arteria pharyngea ascendens (HAI161)
descending genicular artery – arteria genus descendens (HAI189)
recurrent laryngeal nerve – nervus laryngeus recurrens (HAI305)

9. Nominative of an adjective (attribute) + nominative of an ordinal (attribute) + nominative of a noun (attribute) \neq nominative of a noun (determinative) + nominative of an adjective (attribute) + nominative of an ordinal (attribute):

$Adj_{CN} + N_{ON} + S_N \neq S_N + Adj_{NP} + N_{ON}$
peroneus tertius muscle – musculus peroneus tertius (HAI366)

Let's compare the data presented in the chart.

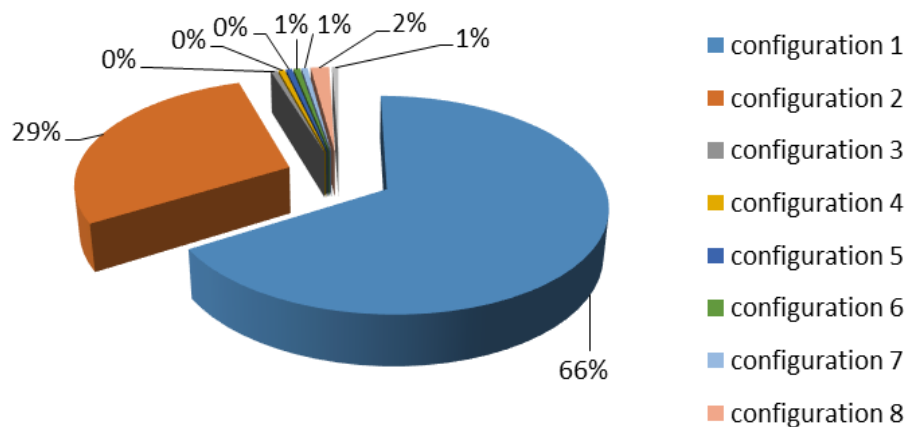


Fig. 1. Frequency of English and Latin three word terms of type 1

The most common are three-word English and Latin terms whose secondary attributes are *agreed attribute + agreed attribute* and whose second secondary elements are a positive adjective and a comparative adjective.

Type 2

English CT	<i>agreed attribute+ non-agreed attribute+ determinative</i>
Latin CT	<i>determinative+ agreed attribute+ agreed attribute</i>

1. Nominative of an adjective (attribute) + genitive of a noun (attribute) + nominative of a noun (determinative) \neq nominative of a noun (determinative) + nominative of an adjective (attribute) + nominative of an adjective (attribute):

$Adj_{NP} + S_G + S_N \neq S_N + Adj_{NP} + Adj_{NP}$

popliteal lymph glands – nodi lymphatici mandibular lymph glands – nodi lymphatici poplitei (HAI135) mandibulares (HAI145)
inguinal lymph glands – nodi lymphatici submental lymph glands – nodi lymphatici inguinales (HAI135) submentales (HAI145)
occipital lymph glands – nodi lymphatici occipitales (HAI145)

2. Comparative of an adjective (attribute) + nominative of a noun (attribute) + nominative of an adjective (attribute) \neq nominative of a noun (determinative) + nominative of an adjective (attribute) + comparative of an adjective (attribute):

Adj_{CN} + S_G + Adj_{NP} ≠ S_N + Adj_{NP} + Adj_{CN}
 superior vena cava – vena cava superior (HAI1101)

Type 3

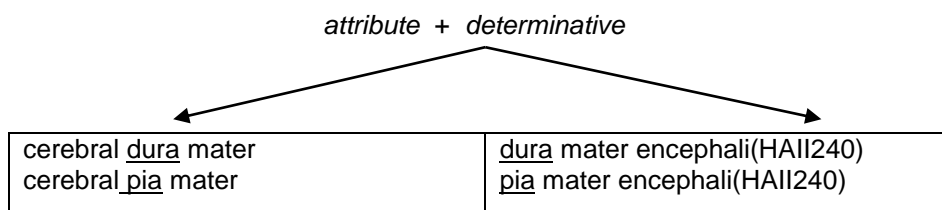
{	English CT		<i>agreed attribute+ agreed attribute+ determinative</i>
	Latin CT		<i>determinative+ agreed attribute+agreed attribute</i>

1. Nominative of an adjective (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) ≠ nominative of an adjective (attribute) + nominative of a noun (determinative) + genitive of a noun (attribute):

Adj_{NP}+ Adj_{NP} + S_N ≠ Adj_{NP} + S_N + S_G
 cerebral dura mater – dura mater encephali (HAI1240)
 cerebral pia mater – pia mater encephali (HAI1240)

According to the usual word order, in the Latin language, the attribute goes after the determinative (Jones, Sidwell, 2002). In Latin, the word order is not very strict, but more often the subject is in the beginning of the sentence; the predicate, in the end; and *the attribute, after the determinative* (Dumčius et al., 1999). Thus, it could be stated that Latin medical terminology has an inverted order of words compared with English. Usually, the elements of English three-word terms are preseted in a certain word order: *attribute + attribute + determinative*, while of Latin three-word terms, *determinative + attribute + attribute*. This is how English nomenclature of anatomy, botany, and zoology differs from Latin nomenclature, in which species attributes always go after the determinative. Sometimes in Latin, an attribute can come before a determinative. According to J. Dumčius, K. Kuzavinis and R. Mironas, if attributes denoting *place* and *time* precede the determinative, they have a predicative meaning, and if they follow the determinative, they have an attributive meaning (Litevkienė, 2006).

The underlined agreed attributes of Latin three-word terms describe a feature of a structural part of the body. With regard to structure, these CTs are equivalent, there is no word order characteristic to Latin here. Hence, the aforementioned principle of Latin word order is violated. This opinion is supported, for example, by P. V. Jones and K. C. Sidwell (Jones, Sidwell, 2002). In an inverted sentence, the attribute precedes the determinative to emphasize, to single out the characteristic that defines a thing or phenomenon, and not the thing or phenomenon itself. They argue that there is an inverted¹⁰order of words in Latin (in Latin, *inversion* means *turning over, rearranging, swapping places; inversio verborum* means *a change of (usual) word order*) (Jones, Sidwell 2002: 600). According to them, it should be noted that in the case of inverted word order, the place of the attribute changes. (Litevkienė, 2006). According to the usual word order, the attribute follows the determinative. It should be emphasized that such type two-word terms are unproductive, although they can also be found in the terminology of other medical fields. Only two pairs of such terms were found.



Type 4

{	EnglishCT		<i>agreed attribute+ non-agreed attribute+ determinative</i>
	Latin CT		<i>determinative+ agreed attribute+ agreed attribute</i>

1. Nominative of an adjective (attribute) + genitive of a noun (attribute) + nominative of a noun (determinative) ≠ nominative of a noun (attribute) + genitive of a noun (determinative) + genitive of a noun (attribute):

Adj_{NP}+ S_G + S_N ≠ S_N + S_G + Adj_{GP}

¹⁰In certain sentence types an inverted (Inversion happens when we change word order), in which an attribute is placed before the determinative.

mammary gland lobules – lobuli glandulae mamariae (HAI1378)

Type 5

English CT	<i>non-agreed attribute+ agreed attribute+ determinative</i>
Latin CT	

1. Genetive of a noun (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) \equiv nominative of a noun (determinative) + nominative of an adjective (attribute) + genetive of a noun (attribute):

$S_G + Adj_{NP} + S_N \equiv S_N + Adj_{NP} + S_G$
eyeball vascular coat – tunica vasculosa bulbi (HAI1402)

Type 6

English CT	<i>agreed attribute+ non-agreed attribute+ determinative</i>
Latin CT	

1. Comparative of a noun (attribute) + genetive of a noun (attribute) + nominative of a noun (determinative) \neq nominative of a noun (determinative) + comparative of an adjective (attribute) + genetive of a noun (attribute):

$Adj_{CN} + S_G + S_N \neq S_N + Adj_{CN} + S_G$
anterior eye chamber – camera anterior bulbi (HAI1409)
posterior eye chamber – camera posterior bulbi (HAI1409)

Type 7

English CT	<i>agreed attribute + agreed attribute+ determinative</i>
Latin CT	

1. Comparative of an adjective (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) \neq nominative of a noun (determinative) + genetive of a noun (attribute) + comparative of an adjective (attribute):

$Adj_{CN} + Adj_{NP} + S_N \neq S_N + S_G + Adj_{CN}$
inferior nasalmeatus – meatus nasi inferior (HAI1202)

The following types of grammatical configurations of English and Latin three-word anatomical terms have been observed to occur most frequently: a) $Adj_{NC} + Adj_{NP} + S_N \equiv S_N + Adj_{NP} + Adj_{NC}$; b) $Adj_{NP} + Adj_{NP} + S_N \equiv S_N + Adj_{NP} + Adj_{NP}$ (they represent 62,7% and 26,4% respectively). The terms of these configurations make up 89,1% of all compound three-word terms found in the textbook *Human anatomy, volume II*. In the type of compound terms the English term *Agreed attribute + agreed attribute + determinative* - the Latin term *determinative + agreed attribute + agreed attribute*, the secondary element is a positive adjective or comparative adjective, present participle, and an ordinal.

It can be stated that out of the investigated English and Latin three-word terms (194), 88,1% are Latin terms related by syntactical relations of the agreed attribute, English terms related by syntactical relations of the agreed attribute make up 92,2%. The CT frequency of both of them is presented in Fig. 1.

The chart below shows how this type of CTs is distributed in both languages by frequency of productivity.

English and Latin agreed attribute terms

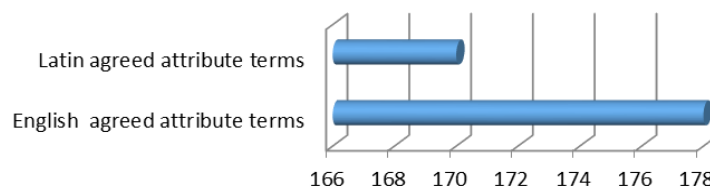


Fig. 2. Statistically this would look like this

ENGLISH AND LATIN FOUR WORD ANATOMICAL TERMS

Most English and Latin anatomical terms are two-word and three-word terms that come in various configurations. It is maintained that there are several times more two-word terms than three-word terms in most scientific fields. Only few four-word English and Latin terms were found in the source. There are two identical configurations of English and Latin four-word terms in the source.

Four-word terms can be expressed by the formula:

$$f(t_1, \dots, t_n) = f(t_1, \dots, t_n), \text{ when } n = 4 \text{ (Litevkienė, 2006).}$$

Seventeen such CTs were found. Five configurations of English and Latin four-word terms are distinguished. In this article, we will discuss the *grammatical configurations of Lithuanian four-word terms* ↔ *Latin four-word terms*.

English four-word anatomical terms and their Latin equivalents form the following more commonly used grammatical configuration:

$$\text{Adj}_{\text{PN}} + \text{Adj}_{\text{PN}} + \text{S}_{\text{G}} + \text{S}_{\text{N}} \equiv \text{S}_{\text{N}} + \text{Adj}_{\text{PN}} + \text{S}_{\text{G}} + \text{Adj}_{\text{CG}}$$

1. Comparative of a noun (attribute) + comparative of an adjective (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) ≡ nominative of a noun (determinative) + nominative of an adjective (attribute) + comparative of an adjective (attribute) + comparative of an adjective (attribute):

$$\text{Adj}_{\text{CN}} + \text{Adj}_{\text{CN}} + \text{Adj}_{\text{PN}} + \text{S}_{\text{N}} \equiv \text{S}_{\text{N}} + \text{Adj}_{\text{PN}} + \text{Adj}_{\text{CN}} + \text{Adj}_{\text{CN}}$$

anterior superior iliac spine – spina iliaca anterior anterior (HAI1239)
posterior superior iliac spine – spina iliaca anterior posterior (HAI1239)

2. Nominative of an adjective (attribute) + nominative of an adjective (attribute) + genitive of a noun (attribute) + nominative of a noun (determinative) ≡ nominative of a noun (determinative) + nominative of an adjective (attribute) + nominative of an adjective (attribute) + genitive of an adjective (attribute):

$$\text{Adj}_{\text{PN}} + \text{Adj}_{\text{PN}} + \text{S}_{\text{G}} + \text{S}_{\text{N}} \equiv \text{S}_{\text{N}} + \text{Adj}_{\text{PN}} + \text{S}_{\text{G}} + \text{Adj}_{\text{PG}}$$

external iliac lymph glands – nodi lymphatici iliaci externi (HAI1137)
internal iliac lymph glands – nodi lymphatici iliaci interni (HAI1137)
medial cutaneous arm nerve – nervus cutaneus brachii medialis (HAI1262)
medial cutaneous forearm nerve – nervus cutaneus antebrachii medialis (HAI1262)
lateral cutaneous thigh nerve – nervus cutaneus femoris lateralis (HAI1262)

3. Nominative of a comparative (attribute) + nominative of an adjective (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) ≠ nominative of a noun (determinative) + nominative of an adjective (attribute) + genitive of a noun (attribute) + nominative of a comparative (attribute):

$$\text{Adj}_{\text{CN}} + \text{Adj}_{\text{PN}} + \text{Adj}_{\text{PN}} + \text{S}_{\text{N}} \neq \text{S}_{\text{N}} + \text{Adj}_{\text{PN}} + \text{S}_{\text{G}} + \text{Adj}_{\text{CN}}$$

posterior cutaneous femoral nerve – nervus cutaneus femoris posterior (HAI1271)

4. Nominative of a comparative (attribute) + nominative of an adjective (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) ≠ nominative of a noun (determinative) + genitive of a noun (attribute) + nominative of an adjective (attribute) + nominative of an adjective (attribute):

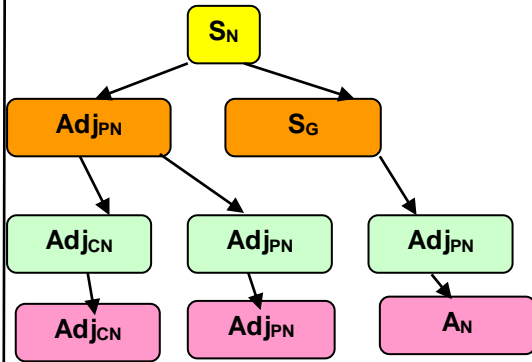
$$\text{Adj}_{\text{CN}} + \text{Adj}_{\text{PN}} + \text{Adj}_{\text{PN}} + \text{S}_{\text{N}} \neq \text{S}_{\text{N}} + \text{S}_{\text{G}} + \text{Adj}_{\text{CN}} + \text{Adj}_{\text{PN}}$$

inferior lateral genicular arteries – arteriae genus inferiores laterales (HAI189)

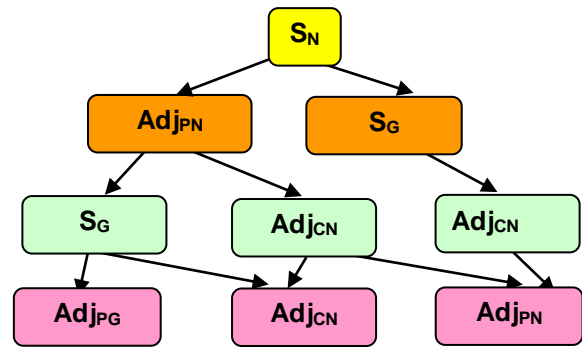
5. Nominative of an adjective (attribute) + nominative of a comparative (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) ≠ nominative of a noun (determinative) + nominative of an adjective (attribute) + nominative of a comparative (attribute) + nominative of an adjective (attribute):

Adj_{PN} + Adj_{CN} + Adj_{PN} + S_N ≠ S_N + Adj_{PN} + Adj_{CN} + Adj_{PN}
lateral anterior maleolar arteries – arteriae malleolares anteriores mediales (HAI194)

Elements of English four-word terms



Elements of Latin four-word terms



Statistically this would look like this:

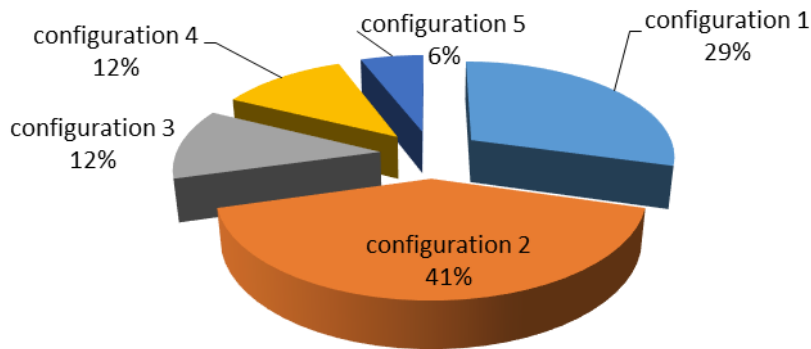


Fig. 3. Configurations of English and Latin four word terms

After analysing English four-word terms, the following regularity was observed: second and third secondary elements in 1,2,3,4,5 configurations are *agreed attributes*. More common are Latin four-word terms whose second and third secondary elements are *agreed attributes*, while in the third configuration, *non-agreed attribute+ agreed attribute* (12% of CTs).

Conclusions

Greek and Latin shaped the conventions of scientific – not only medical – writing for over 2000 years. In the Middle Ages both Latin and Middle English were acceptable in medical communication. 19th century was when the reign of Latin in teaching and writing medicine virtually ended. The effect of that reign, however, is visible to date in the relative similarity of medical languages in the Western world, especially in Western languages. The importance of the exact and precise description of anatomy and disease has been emphasized since the very early stage of the development of Medicine.

M. Prives, V. Bushkovich, N. Lisenkov *Human Anatomy* (1985) textbook *Human anatomy* consists of two volumes. Volume I includes: the weight-bearing and locomotor system, the science of the viscera, the science of the organs of internal secretion. Volume II includes: the science of the vessels, the science of the nervous system, the science of the sensory organs. At the end of both volumes there are subject indices. Compound terms used in the first volume are discussed in previous articles. Most of anatomical terms in volume two are two-word and three-word terms. This article analyses three-word and four-word terms and discusses the variety and frequency of grammatical configurations. English three-word anatomical terms and their Latin equivalents form two more commonly used types of grammatical configurations: Adj_{CN}+ Adj_{NP} + S_N ≡ S_N + Adj_{NP} + Adj_{CN}; Adj_{NP} + Adj_{NP} + S_N ≡ S_N + Adj_{NP} + Adj_{NP}. Most of the secondary elements of three-word terms are made up of *agreed attributes*. The second and third secondary elements of English four-word terms are *agreed attributes*. Latin four-word terms in which the second and third secondary elements are *agreed attributes* are found more often.

Resource

HA – Human Anatomy – Prives, Mikhael; Bushkovich, Viacheslav; Lisenkov, Nikolai. *Human Anatomy (Vol.I)*.1985, Mir Publishers.

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ENGLISH FOUR AND FIVE WORD ANATOMICAL TERMS AND THEIR LATIN EQUIVALENTS IN THE TEXTBOOK *HUMAN ANATOMY(VOL.I)*

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Annotation

This research is aimed to identify the peculiarities of compound English and Latin anatomical terms, based on comparative description of structural forms of compound terms. An essential role in medical vocabulary creation has been played by Greek, Latin, English. This research was based on the use of such methods of linguistic analysis. In the textbook „Human Anatomy”, M. Prives, V. Bushkovich, N. Lisenkov offer a progressive view descriptive, evolutionary, functional, and practical anatomy. Medical terms in the textbook can be basically divided into one-word and multiple word terms. One-word terms can be simple words, derived words, compounds, or combination of derived and compound words. Compound anatomical terms can consist of two-five words. The article presents the analysis of four-word and five-word English and Latin anatomical terms and the analysis of their specific configurations.

Key words: *identity of term, difference of terms, Latin anatomical terms, compound anatomical terms.*

Introduction

One of the most common linguistic phenomena is the occurrence of different forms of influence of one language upon another. Although importance of medical language has increased enormously, “there is no recognized discipline called medical linguistics” (Wulff, 2004). It almost always refers to living languages that are still in their natural development or at least language which is influenced is a living one. The present paper is designed to describe a unique phenomenon, a significant effect of modern English upon a dead language, Latin, occurring at the turn of the 20th century. The aim of this short study is also to focus attention on this phenomenon especially because sources for its investigations are disappearing very quickly. Latin lost its role as a national language with demise of the Roman Empire, however, it was still a common language of the Roman Catholic Church, European politics and all forms of academic activity. Since the end of the Renaissance and a concomitant increase in the role of national languages, Latin was no more used for interpersonal communication either in academic circles or in international relations (Kucharz, 2016).

Hippocrates' writings from the 5th and 4th centuries BC are considered to be the oldest written sources of western medicine. They contain numerous medical terms that later penetrated to various national medical vocabularies, e.g. diarrhoea, dyspnoea, podagra, etc. At the beginning of the first century AD, Aulus Cornelius Celsus wrote *De Medicina* - an encyclopaedic overview of medical knowledge based on Greek sources. In his work, he either imported some Greek terms directly, latinized Greek words by replacing Greek endings with Latin ones, e.g. stomachus and brachium, or translated Greek terms into Latin, e.g. kynodontes (Gr.) > dentes canini (L) > canines (Engl.) (dog teeth). During the Middle Ages, at the time of the Renaissance, when Greek was no longer widely understood, the era of medical Latin began. “During the subsequent centuries almost all important medical works were published in Latin (e.g. those by Vesalius, Harvey and Sydenham)”. Gradually, however, national languages such as English, French, Italian, Spanish and German gained ground at the expense of Latin. National languages continued in coining new terms with Greek and Latin roots, e.g. nephrectomy, ophthalmoscopy, erythrocyte, leucocyte, etc. (Džuganová, 2019).

In 55 and 54 BC, Julius Caesar invaded Britain. The Romanization of Britain, however, did not occur until almost 100 years later when expeditionary forces were sent out by the Roman emperor Claudius. Although Latin was the official language during the Roman occupation of Britain, Celtic, the native language of the people of Britain, was little affected by it. As is stated in Dunmore and Fleischer's *Medical Terminology*, the English language began its development as an independent language with the migration of Germanic people (Angles, Saxons, and Jutes) from Western Europe across the English Channel to Britain during the 5th and 6th centuries AD. These Germanic invaders, in contact with the Romans from the 1st century BC on, brought with them not only their native language but also the Latin words they had borrowed from the

Romans. Their language, known as Old English or Anglo-Saxon, was a member of the Germanic family of Indo-European languages and gradually superseded the Celtic dialects in most of southern Britain. Many Old English words have survived, with some linguistic change, to form the basic vocabulary of the English language (Anglo-Saxon had some basic medical terminology, e.g. head, skull, brain, nose, blood, wound, sore) (Bujalková, 2018). Words borrowed from other languages – mostly Latin, French, and Greek – have been added to the English language.

English medical terminology developed from medieval Latin terminology, which had absorbed a developed Greek terminology. Only a few medical terms come from the oldest developmental period of English language (from Anglo-Saxon). During the Middle Ages, French became an excellent medium for introducing new medical terms developed from Greek/Latin elements. Nowadays English more and more uses its own language material for creation of new terms. Since the 17th century, when the grammar system of Modern English was standardised in its basic features, a constant growth of vocabulary can be observed. This was influenced mainly by the technical and scientific revolution, which brought about a lot of new phenomena that had to be denominated. Besides permanent enrichment of Modern English vocabulary, the most important task in the history of post-Renaissance English was to standardise it because already at that time there was a big discrepancy between its spoken and written forms. This happened by means of vocabularies that started to appear 1755 when Dr. Samuel Johnson published his Dictionary of the English Language in two volumes (Džuganová, 2002).

Employing descriptive and comparative methods, the article analyzes the terminology of one of the fields of medical science – anatomical terminology in the textbook *Human Anatomy* (1985) by M. Prives, V. Bushkovich, N. Lisenkov. The textbook on human anatomy by M. Prives, V. Bushkovich, N. Lisenkov under the general editorship of prof. M. Prives reflects the data on anatomical science and offers a number of advantages over other textbook. *Human Anatomy* offers a progressive view descriptive, evolutionary, functional, and practical anatomy. The textbook approaches the human organism both analytically, according to organs and systems, and synthetically, as a discrete unit with close ties to the environment, especially to society. The book also contains a discussion of the influence of social factors, including the influence of extreme social conditions, on the structure of the human organism and includes a section on new trends in anatomical science under investigations by Prives. The textbook also contains information on the study of X-ray anatomy, the anatomy of the living human being. The textbook is available both for the traditional view of anatomy as the science of the human body structure and for its presentation of anatomy as the science of the natural laws regulating the structure and development of the human organism in relation to the environment. Anatomy is thus seen not as the stagnant subject of university courses but as a progressive science with important prospects. The textbook has been published four times in Spanish for the use in Latin America (Prives et al., 1985).

The basis of the study is 695 English anatomical terms and 695 Latin anatomical terms (a total of 1390 terms). Compound anatomical terms are divided into: two-word, three-word, four-word, five-word terms. The diversity of the number of elements of compound terms is given by the formula $f^1 (t_1 \dots t_n)$, when $n = 2, n = 3, n = 4, n = 5$. The terms that were found also include repetitive the same Latin terms whose grammatical configurations of English equivalents are different as well as a part of long compound anatomical terms that are like a kind of explanations of concepts (Litevkienė, 2006).

Sometimes the concept of the term does not fit within the boundaries of a “word”, because the term can be both a single word and a constant combination of words (Gaivenis, 2002). Depending on the number of words that make up the term, medical terms, like terms in general, are divided into one-word terms and compound terms (hereinafter, CT). In the nomenclature of anatomy, *Nomina Anatomica*, the axial names of parts of the human body are one-word terms. All one-word Lithuanian and Latin anatomical terms are nouns. One-word anatomical terms make up only a small proportion of anatomical terms. They are used to name the concepts of the main parts and organs of the human body.

The research object of this article is the English and Latin compound anatomical terms in the textbook *HUMAN ANATOMY(VOL.I)*

Aims of the article. The comparative analysis of syntagmatic relationships of compound anatomical terms in the aspects of coincidence and difference. To achieve that aim, the following objectives are set:

- To discuss English and Latin compound anatomical terms according to the diversification of elements.
- To examine the aspects of difference and coincidence between English and Latin four-word and five-word anatomical terms and their structural groups.
- To systematize diversification aspects of elements of English and Latin terms.

Research material and methods. Using descriptive and comparative methods the terminology of anatomy is analysed. A descriptive analytical method was employed to perform quantitative and qualitative analyses.

In terms of origin, terms are different: they can be formed on the basis of the lexicon of one's own language (Litevkienė, 2006): *wrist joint – articulatio radiocarpica* (HA232), *knee cap – patella* (HA248), *hip joint – articulatio coxae* (HA249), *knee joint – articulatio genus* (HA256), *long head – caput longum* (HA336), *saddle joint – articulatio sellaris* (HA126), *true ribs – costae verae* (HA150) *false ribs – costae spuriae* (HA150), *floating ribs – costae fluctuantes* (HA150), *simple glands – glandulae simplices* (HA389), *muscular coat – tunica muscularis* (HA390), *teeth – dentes* (HA395), *gums – gingivae* (HA398), *gal bladder – vesica fellea* (465), *right lung – pulmo dexter* (HA515), *left lung – pulmo sinister* (HA515), *womb – uterus* (HA563); borrowed: *occipital artery – arteria occipitalis* (HA55), *ophthalmic artery – arteria ophthalmica* (HA60), *medial cerebral artery – arteria cerberii media* (HA61), *subclavia artery – arteria subclavia* (HA61), *vertebral artery – arteria vertebralis* (HA62), *basilar artery – arteria basilaris* (HA63), *axillary artery – arteria axillaris* (HA65), *brachial artery – arteria brachialis* (HA67), *anterior horn – cornu anterius* (HA230), *coronal suture – sutura coronalis* (HA195), *anterior cranial fossa – fossa cranii anterior* (HA197), *humeral condyle – condylus humeri* (HA218), *sacral tuberosity – tuberositas sacralis* (HA137), *coccygeal vertebrae – vertebrae coccygeae* (HA138), *jugular process – processus jugularis* (HA165), *oval foramen – foramen ovale* (HA167), *frontal squama – squama frontalis* (HA176), *frontal sinus – sinus frontalis* (HA177), and, finally, mixed, or hybrids: *mental tubercle – tuberculum mentale* (HA187), *squamous suture – sutura squamosa* (HA190), *lateral ligament – ligamentum laterale* (HA191), *superior orbital fissure – fissura orbitalis superior* (HA193), *pubic tubercle – tuberculum pubicum* (HA239), *lateral inguinal fossa – fossa inguinalis lateralis* (HA312), *falciform margin – margo falciformis* (HA373), *vallate papillae – papillae vallatae* (HA411), *caudate process – processus caudatus* (HA463), *parietal pleura – pleura parietalis* (HA516); *right ventricle – ventriculus dexter* (HA30), *papillary muscles – muscoli papillares* (HA30), *left ventricle – ventriculus sinister* (HA31), *fibrous rings – anuli fibrosis* (HA3), *right crus – crus dextrum* (HA34), *left crus – crus sinister* (HA34), *sternocostal surface – facies sternocostalis* (HA43), *deep palmar arch – arcus palmaris profundus* (HA72), *parietal branches – rami parietales* (HA73), *visceral branches – rami viscerales* (HA75), *femur head – caput femoris* (HA247), *alar folds – plicae alare* (HA258), *navicular bone – os naviculare* (HA263), *trapezius muscle – musculus trapezius* (HA290), *lateral head – caput laterale* (HA336), *tendon sheath – vagina tendinum* (HA352), *medial groove – sulcus medialis* (HA379), *femoral ring – anulus femoralis* (HA379), *muscular coat – tunica muscularis* (HA390), *muscular branches – rami musculares* (HA89), *mamillary bodies – corpora mamillaria* (HA181), *fourth ventricle – ventriculus quartus* (HA197).

One-word English and Latin anatomical terms are nouns. One-word anatomical terms make up only a small portion of anatomical terms. This article excludes one-word derived and compound terms that form a small share of anatomical terms: English one-word terms make up 2,7% of the number of anatomical terms found, Latin one-word terms make up 3,45% of the number of terms found. Most of these anatomical terms are simple English and Latin or Greek root words. One-word terms are used to name the concepts of the main parts and organs of the human body: *bone – os* (HA90), *eyesockets – orbitae* (HA193), *clavicle – clavicula* (HA212), *fontanelles – fonticuli* (HA203), *cheeks – buccae* (HA392), *palate – palatum* (HA393), *teeth – dentes* (HA395), *gums – gingivae* (HA398), *dentine – dentinum* (HA399), *enamel – enamelum* (HA399), *cement – cementum* (HA399), *tongue – lingua* (HA399), *lungs – pulmones* (HA399), *kidney – renes* (HA527), *prostate – prostata* (HA556), *ovary – ovarium* (HA560), *womb – uterus* (HA563), *vagina – vagina* (HA569). Although one-word terms are often considered better and more convenient to use, in science, technology and other special fields of human activity, more complex concepts are usually named by using compound terms, which form the majority of terms in many fields.

Most terms in medical terminology are compound. According to A. M. Rassinoux, (2000), compound terms are most productive. S. W. Haas, R. M. Losee investigated the cases of term use and their frequency in natural languages (Losee, R. M., Haas, S. W., 1995). In their opinion, word combinations can have a precise scientific expression, because the more words make up the term, the more precisely it can be expressed.

According to foreign scientists E. Marečková, F. Simon, L. Červený, Latin compound terms form a separate group in medical terminology. Their productivity is determined by the suitability of the Latin language to economically and succinctly express an idea when the native language equivalent is expressed in a periphrasis (Marečková, Simon, Červený, 2002). Compound two-word terms denoting the *main* parts and organs of the human body in the international document *Nomina Anatomica* are a minority (Litevkienė, 2006).

It is maintained that there are several times more two-word terms than three-word terms in most scientific fields. Statistically, Latin two-word anatomical terms make up 31% of all found Latin compound anatomical terms; English two-word terms found make up 32%. English five-word terms make up only 1% of all English compound anatomical terms found. Latin five-word terms also make up only 1% of all Latin compound anatomical terms found. The examples show that no English and Latin six-eight-word anatomical terms are found. Supposedly, such Latin and English compound *anatomical* terms occur only in clinical terminology(Litevkienė, 2006).

Let's compare the data presented in the chart.

- | | | |
|---------------------------|----------------------------|---------------------------|
| ■ English one word terms | ■ Latin one word terms | ■ English two word terms |
| ■ Latin two word terms | ■ English three word terms | ■ Latin three word terms |
| ■ English four word terms | ■ Latin four word terms | ■ English five word terms |
| ■ Latin five word terms | | |

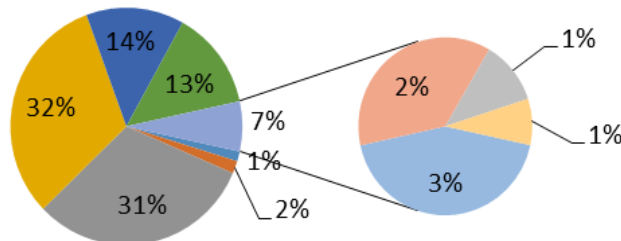


Fig. 1. Frequency of English and Latin compound terms

Four-word terms can be expressed in the formula:
 $f^{11}(t_1, \dots, t_n) = f(t_1, \dots, t_n)$, when $n = 4$ (Litevkienė, 2014).

The grammatical configurations of English and Latin four-word terms can be grouped by elements as follows:

English four-word terms ↔ *Latin four-word terms*;
English four-word terms ↔ *Latin three-word terms*.

Thirty five compound term pairs of four-word terms were found. This accounts for only 3% of investigated English anatomical terms. This represents 2% of investigated Latin anatomical terms.

ENGLISH FOUR WORD ANATOMICAL TERMS AND THEIR LATIN EQUIVALENTS ENGLISH AND LATIN FOUR WORD ANATOMICAL TERMS

The following configurations of English and Latin four-word terms are distinguished:

1. Nominative of an adjective (attribute) + nominative of the comparative adjective (attribute) + nominative of the comparative adjective (attribute) + nominative of a noun (determinative) ≠¹² nominative of a noun (determinative) + nominative of the comparative adjective (attribute) + (attribute) + nominative of the comparative adjective (attribute) + nominative of an adjective (attribute) (Litevkienė, 2014):

$A^{13}dj_{NP} + Adj_{NC} + Adj_{NC} + S_N \neq S_N + Adj_{NP} + Adj_{NC} + Adj_{NC}$
serratus posterior superior muscle – musculus serratus posterior superior (HA291)
serratus posterior inferior muscle – musculus serratus posterior inferior (HA291)
obliquus capitis superior muscle – musculus obliquus capitis superior (HA294)
obliquus capitis inferior muscle – musculus obliquus capitis inferior (HA294)

2. Nominative of an adjective (attribute) + nominative of the comparative adjective (attribute) + nominative of the mixed formation adjective (attribute) + nominative of a noun (determinative) ≠ nominative of a noun (determinative) + nominative of the mixed formation adjective (attribute) + (attribute) + nominative of an adjective (attribute) + nominative of an adjective (attribute):

¹¹The author grounds on the theory Ross Moore, a mathematician of Macquarie University (Sydney) and Nika Draka, a programmer of Leeds University (England) about the construction of compound term computerized systems, symbols and the diversification of compound term systems.

¹² different

¹³S – substantive; A – adjective; P – participle; N – numeral; N_o – ordinal; Pr – pronoun; N_n – nominative; g – genitive; s – simple; c – comparative; s – superlative; c – compound; m – mixed composition, p – positive

$Adj_{NP} + Adj_{NC} + Adj_{NC} + S_N \neq S_N + Adj_{NC} + Adj_N + Adj_N$
 deep posterior sacrococcygeal ligament – ligamentum sacrococcygeum dorsale profundum (HA145)
 superficial posterior sacrococcygeal ligament – ligamentum sacrococcygeum dorsalis superficiale (HA145)

3. Nominative of an adjective (attribute) + genitive of a noun (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) \equiv nominative of a noun (determinative) + nominative of an adjective (attribute) + genitive of a noun (attribute) + nominative of an adjective (attribute):

$Adj_{NP} + S_G + Adj_{NP} + S_N \equiv^{14} S_N + Adj_{NP} + S_G + Adj_{NP}$
 levatores costarum breves muscles – musculus levatores costarum breves (HA294)
 levatores costarum longi muscles – musculus levatores costarum longi (HA294)
 flexor digitorum sublimis muscle – musculus flexor digitorum superficialis (HA339)
 flexor pollicis longus muscle – musculus flexor pollicis longus (HA340)
 flexor digitorum profundus muscle – musculus flexor digitorum profundus (HA341)
 extensor hallucis longus muscle – musculus extensor hallucis longus (HA366)
 flexor digitorum accessorius muscle – musculus quadratus plantae accessories (HA372)
 middle pharynx constrictor muscle – musculus constrictor pharyngis medius (HA420)
 tensor fasciae latae muscle – musculus tensor fasciae latae (HA)358
 extensor carpi ulnaris muscle – musculus extensor carpi ulnaris (HA344)
 extensor digitorum longus muscle – musculus extensor digitorum longus (HA366)

4. Nominative of an adjective (attribute) + genitive of a noun (attribute) + genitive of a noun (attribute) + nominative of a noun (determinative) \neq nominative of a noun (determinative) + nominative of an adjective (attribute) + genitive of a noun (attribute) + genitive of a noun (attribute):

$Adj_{NP} + S_G + S_G + S_N \neq S_N + Adj_{NP} + S_G + S_G$
 depressor anguli oris muscle – musculus depressor anguli oris (HA329)
 depressor labii inferioris muscle – musculus depressor labii inferioris (HA329)

5. Nominative of an adjective (attribute) + nominative of an adjective (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) \neq nominative of a noun (determinative) + nominative of an adjective (attribute) + nominative of an adjective (attribute) + genitive of a noun (attribute):

$Adj_{NP} + Adj_{NP} + Adj_{NP} + S_N \neq S_N + Adj_{NP} + Adj_{NP} + S_G$
 external oblique abdominal muscle – musculus obliquus externus abdominis (HA302)
 internal oblique abdominal muscle – musculus obliquus internus abdominis (HA302)
 deep transverse metacarpal ligaments – ligamenta metacarpea transversa profunda (HA236)

6. Nominative of the comparative adjective (attribute) + nominative of a noun (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) \neq nominative of a noun (determinative) + genitive of a noun (attribute) + genitive of an adjective (attribute) + genitive of the comparative adjective (attribute):

$Adj_{NC} + S_N + Adj_{NP} + S_N \neq S_N + S_G + Adj_{GP} + Adj_{GC}$
 greater sulcus petrosal nerve – sulcus nervi petrosi majoris (HA171)
 lesser sulcus petrosal nerve – sulcus nervi petrosi minoris (HA171)

7. Nominative of an adjective (attribute) + genitive of a noun (attribute) + nominative of the superlative adjective (attribute) + nominative of a noun (determinative) \neq nominative of a noun (determinative) + nominative of an adjective (attribute) + genitive of a noun (attribute) + genitive of the superlative adjective (attribute):

$Adj_{NP} + S_G + Adj_{NS} + S_N \neq S_N + Adj_{GP} + S_G + Adj_{GS}$
 extensor digiti minimi muscle – musculus extensor digiti minimi (HA344)
 abductor digiti minimi muscle – musculus abductor digiti minimi (HA348)

8. Nominative of an adjective (attribute) + genitive of a noun (attribute) + nominative of the superlative adjective (attribute) + nominative of a noun (determinative) ≠ nominative of a noun (determinative) + nominative of an adjective (attribute) + genitive of a noun (attribute) + genitive of the superlative adjective (attribute):

$Adj_{NP} + S_G + Adj_{NS} + S_N \neq S_N + Adj_{GP} + S_G + Adj_{GS}$
groove inferior petrosal sinus – sulcus sinus petrosi inferioris (HA165)

9. Nominative of the comparative adjective (attribute) + nominative of the comparative adjective (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) ≡ nominative of a noun (determinative) + nominative of an adjective (attribute) + nominative of the comparative adjective (attribute) + nominative of the superlative adjective (attribute):

$Adj_{NC} + Adj_{NC} + Adj_{NP} + S_N \equiv S_N + Adj_{GP} + Adj_{GC} + Adj_{GC}$
anterior superior illae spine – spina iliaca anterior superior (HA239)

10. Nominative of a participle (attribute) + genitive of a noun (attribute) + nominative of the superlative adjective (attribute) + nominative of a noun (determinative) ≠ nominative of a noun (determinative) + nominative of a participle (attribute) + genitive of a noun (attribute) + genitive of the superlative adjective (attribute):

$P_N + Adj_{NC} + Adj_{NP} + S_N \neq S_N + P_N + Adj_{GC} + Adj_{GC}$
opponens digiti minimi muscle – musculus opponens digiti minimi (HA372)

11. Nominative of the comparative adjective (attribute) + nominative of an adjective (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) ≠ nominative of a noun (determinative) + nominative of an adjective (attribute) + genitive of a noun (attribute) + nominative of the superlative adjective (attribute):

$Adj_{NC} + Adj_{NP} + Adj_{NP} + S_N \neq S_N + Adj_{NP} + S_G + Adj_{NC}$
posterior circumflex humeral artery ≠ arteria circumflexa humeri posterior (HA67)
anterior circumflex humeral artery ≠ arteria circumflexa humeri anterior (HA67)

12. Nominative of the ordinal (attribute) + nominative of an adjective (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) ≠ nominative of a noun (determinative) + nominative of an adjective (attribute) + nominative of an adjective (attribute) + nominative of a ordinal (attribute):

$NON + Adj_{NP} + Adj_{NP} + S_N \neq S_N + Adj_{NP} + S_G + NON$
first dorsal metacarpal artery ≡ arteria metacarpea dorsalis prima (HA70)

Let's compare the data presented in the chart.

- configuration 1 ■ configuration 2 ■ configuration 3 ■ configuration 4
- configuration 5 ■ configuration 6 ■ configuration 7 ■ configuration 8
- configuration 9 ■ configuration 10 ■ configuration 11 ■ configuration 12

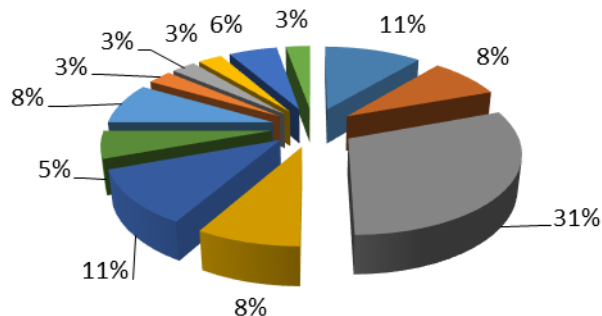


Fig. 2. Frequency of grammatical configurations of English and Latin four word terms

English and Latin four-word terms most commonly occur in three configurations. Their secondary elements are: *English CT – agreed attribute + non-agreed attribute + agreed attribute*, *Latin CT – agreed attribute + non-agreed attribute + agreed attribute* and *English CT*

– *agreed attribute + agreed attribute + agreed attribute*, Latin CT – *agreed attribute + agreed attribute + non-agreed attribute*. Identical terms among English and Latin four-word terms are found in 3, 9, 12 configurations. This represents 37,1% of all four-word terms found in the source. Terms of 8, 9, 10, 12 configurations are rare, they represent only 3%. The most productive are terms of the third configuration, whose secondary elements are: English and Latin terms – *agreed attribute + non-agreed attribute + agreed attribute*.

ENGLISH FOUR WORD ANATOMICAL TERMS AND THREE WORD LATIN TERMS

The following grammatical configurations are distinguished:

1. Nominative of the comparative of an adjective (attribute) + nominative of an adjective (attribute) + nominative of a noun (attribute) + nominative of a noun (determinative) ≠ nominative of a noun (determinative) + nominative of an adjective (attribute) + genitive of a noun (attribute):

$$\text{Adj}_{\text{NC}} + \text{Adj}_{\text{NC}} + \text{S}_{\text{G}} + \text{S}_{\text{N}} \neq \text{S}_{\text{N}} + \text{Adj}_{\text{NP}} + \text{S}_{\text{G}}$$

anterior bony nose aperture – apertura piriformis nasi (HA193)

2. Nominative of a noun (attribute) + genitive of a noun (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) ≠ nominative of a noun (determinative) + genitive of a noun (attribute) + nominative of an adjective (attribute):

$$\text{S}_{\text{N}} + \text{S}_{\text{G}} + \text{Adj}_{\text{NP}} + \text{S}_{\text{N}} \neq \text{S}_{\text{N}} + \text{S}_{\text{G}} + \text{Adj}_{\text{NP}}$$

skull base external surface – basis cranii externa (HA195)

Only two pairs of three-word and four-word compound terms were found in the source.

ENGLISH FIVE WORD ANATOMICAL TERMS AND THEIR LATIN EQUIVALENTS

Five-word terms can be expressed by the formula:

$$f(t_1, \dots, t_n) = f(t_1, \dots, t_n), \text{ when } n = 5 \text{ (Litevkienė, 2006)}$$

Only one percent of the five-word English and Latin terms were found in the source. The grammatical configurations of five-word English anatomical terms and their Latin equivalents are as follows:

1. Nominative of an adjective (attribute) + nominative of a noun (attribute) + nominative of an adjective (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) ≠ nominative of a noun (determinative) + nominative of an adjective (attribute) + genitive of a noun (attribute) + genitive of a noun (attribute) + nominative of an adjective (attribute):

$$\text{Adj}_{\text{NP}} + \text{S}_{\text{G}} + \text{Adj}_{\text{NP}} + \text{S}_{\text{G}} + \text{S}_{\text{N}} \neq \text{S}_{\text{N}} + \text{Adj}_{\text{NP}} + \text{S}_{\text{G}} + \text{S}_{\text{G}} + \text{Adj}_{\text{NP}}$$

extensor carpi radialis brevis muscle – musculus extensor carpi radialis brevis (HA344)

2. Nominative of an adjective (attribute) + nominative of a noun (attribute) + nominative of an adjective (attribute) + nominative of an adjective (attribute) + nominative of a noun (determinative) ≠ nominative of a noun (determinative) + nominative of an adjective (attribute) + nominative of an adjective (attribute) + genitive of a noun (attribute) + genitive of an adjective (attribute):

$$\text{Adj}_{\text{NP}} + \text{S}_{\text{G}} + \text{Adj}_{\text{NP}} + \text{Adj}_{\text{NP}} + \text{S}_{\text{N}} \neq \text{S}_{\text{N}} + \text{Adj}_{\text{NP}} + \text{Adj}_{\text{NP}} + \text{S}_{\text{G}} + \text{Adj}_{\text{GP}}$$

flexor tendons common synovial sheath – vagina synovialis communis musulorum flexorum (HA354)

extensor carpi radialis brevis muscle – musculus extensor carpi radialis brevis (HA344)

No identical English and Latin five-word terms were found in the source. Secondary elements in English and Latin four-word terms are distributed as follows:

English terms	<i>agreed attribute + non-agreed attribute + agreed attribute + agreed attribute</i>
Latin terms	<i>agreed attribute + non-agreed attribute + non-agreed attribute + agreed attribute</i>
English terms	<i>agreed attribute + non-agreed attribute + agreed attribute + agreed attribute</i>
Latin terms	<i>agreed attribute + agreed attribute + non-agreed attribute + agreed attribute</i>

Conclusions

Compound terms composed of four elements are characterized by structural diversity. The examples found show that more common English four-word terms are of the type $Adj_N + Adj_N + Adj_N + S_N$, to which the following configurations belong: 1, 2, 4, 7, 8, while more common Latin four-word terms are of the type $S_N + Adj_N + Aadj_N + Adj_N$ and occur in configurations 1, 2, 5, 8. Identical pairs of four-word English and Latin terms found in the source make up 51,2% (third and ninth configurations). Thirty five compound term pairs of four-word terms were found. This accounts for only 3% of investigated English anatomical terms. This represents 2% of investigated Latin anatomical terms.

After analysing 35 English four-word terms and their Latin equivalents, the following regularity was observed: in 61,3% of all English terms of this type, the second and third secondary elements were *agreed attributes*; in 38,7%, the second and third secondary elements were *non-agreed attributes* and *agreed attributes*. Four-word English and Latin terms whose secondary elements are the active or passive participle and an ordinal are rare.

It was already mentioned in the article that English five-word anatomical terms were not common. They account for 1% of all compound terms found in the source. The analysed examples show that Latin five-word terms are rare. They represent only 1% of all compound terms found in the source. No identical pairs of five-word anatomical terms were found.

Almost half of English four-word terms (41 found in the source) and Latin four-word terms (35 found in the source) have different grammatical configurations. Attributive elements of the majority of Latin four-word terms are comparative adjectives. Only one percent of the five-word English and Latin terms were found in the source. Grammatical configurations of *English five-word terms* and *Latin five-word terms* are different. The analysis of English and Latin compound anatomical terms supplements general research on medical terminology, highlights the commonalities and differences between Latin and English languages, which determine the trends in the formation of terminology in this scientific field, which could be used as guidelines in writing anatomy textbooks, preparing dictionaries of medical terms and anatomy atlases.

Resource

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100% TECHNOLOGY-MEDIATED ADMISSION IN TALLINN HEALTH CARE COLLEGE: APPLICANTS' FEEDBACK

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Annotation

There is a broad agreement that health care and medical school admission procedure should meet several criteria, e.g. objectivity, reliability, validity, and effectiveness as the most important characteristics that entrance exams should have. The 2020 admission process was different from all the previous years' and we expected that health care students applicants may have difficulties with web-based interviews and tests, especially in the case of vocational students who have less experience with web-based technology. The online questionnaire study was conducted to investigate the applicants' level of satisfaction with the admission process provided by College.

As the result of the current study the clear standards for online admission procedure have been developed in Tallinn Health Care College to modernize the online admission process and make it more credible and transparent for applicants. The study aims to summarize and draw appropriate conclusions and recommendations not only in X College but also in health care education institutions worldwide based on the study¹⁵.

Key words: Health Care Education, Admission Process, Interview, Admission Test, Applicants, Feedback, Satisfaction.

Introduction

To improve health care for individuals and the whole population, health care professionals will be required to become members of the team-based patient care models necessary to achieve these goals. The first documented report which included an assessment of how medical school admission practices have changed across the decades was written by an American educator Abraham Flexner, who was best known for his contribution to the 20th-century reform of medical and higher education in the United States and Canada. Flexner pointed out that the country needs better medical professionals, and that the way to get them is to produce fewer. Flexner argued that future medical professionals should have at least knowledge of basic school natural sciences. Flexner was also in favour of linking study to practice in order to further develop medical schools by providing a learning experience in a patient care environment ¹.

Several factors influence medical and health care school admissions. The definition of a qualification profile and the fairness of the examination are considered very important. In addition to cognitive skills and learning abilities, non-cognitive characteristics are crucial indicators for successful work in healthcare. The selection of future health professionals cannot be based solely on the results of high school final exams or on the average grade. As a predictor of the potential success of a future student in medical school, the evaluation of applicants also outside their average scores is very important. Therefore, in addition to the admission test which evaluates student candidate cognitive skills, there will also be admission interviews, which are also called mini-interviews. These are face-to-face interviews to help the Admissions Committee get to know the student candidate as a person and not just as a student, and evaluate their non-cognitive skills and readiness to work with individuals who need the help of the health care system. The interview is a kind of screening tool to help evaluate medical and health care school applicants.

The admissions process of Tallinn Health Care College is regulated by the College Admission Regulation, approved by the Council of the College Decision No 2.1 of September 16, 2014. The admission process is based on three pillars - the average grade of a high school diploma, a written test plus exams in some specialities, and finally, an interview. Thus, both

cognitive and personal characteristics, so-called non-cognitive skills, which are necessary for every healthcare professional, are assessed. The first step is the submission of application and documents electronically in the Admission Information System www.sais.ee or if necessary, on location at the College, followed by conducting an admission test (technology-mediated), admission interview and practical admission tests in some disciplines (e.g. for dental technology, pharmacy and optometry curriculums). The candidate will receive a deadline by which to complete the admission test and the dates and times of the admission interview and practical tests after confirmation of the application. It is important to find out during the entrance interview the existence of professional motivation, readiness for studies, knowledge of the profession, ethical attitudes, expression skills in Estonian and general communication skills and readiness for studies are examined.

When evaluating candidates for master's studies, the candidate's weighted average grade on the academic transcript of applied higher education is taken into account (diploma supplement). Candidates must also submit a conceptual design of the development project, which must include problem handling, use of information, project vision, mission and main activities, willingness to cooperate, self-reflection. The admission interview assesses study motivation, analytical skills, readiness to lead professional or speciality development work, and their readiness for studies.

Tallinn Health Care College started conducting feedback surveys of college admissions in 2006. The survey is conducted twice a year - immediately after the summer admission tests in July-August and after the winter admission tests in January.

Summer 2020 differed from previous years in that the entire admission process was web-based - from the receipt of documents in the learning information system to the admission test, tests and interview.

The structure of the admission feedback survey has changed a lot over the years. This research measured whether applicants were satisfied with the admission order or not, how the organization of admission was built up, and how admission tests and interviews were organized and conducted. Thanks to the survey, the College has the opportunity to improve its work related with admission process even better in the future. For this purpose the following research questions were raised:

1. How new conditions changed admissions' attitudes towards the different steps of the admission process and the process as a whole?
2. How the satisfaction level of candidates was reflected by the web-based only admission process?
3. What can the Tallinn Health Care College do to make the admission process smoother, more comprehensible and more transparent in the future?

The admissions process to medical and health care educational institutions has been studied to great length around the world. The interview process has been thoroughly researched. Unfortunately, the author of this article did not find any surveys on candidate feedback and satisfaction with respective admission processes. Therefore the results of a current research can give an overview of the extent to which the admission process in Tallinn Health Care College meets applicants expectations.

Literature Review

A qualification profile of future health care student should cover all the competencies necessary for successful study and, especially in the case of medicine, for the successful attainment of the workforce (as far as these competencies are not trained in the curriculum). All these competencies should be assessed at the entrance examination² (Spiel & Schober, 2018, 61). Discussions on what kind should be "good medical/health professional" has tried to define the core future medical graduates should to become qualified and caring professionals³. In addition to academic success, there is a continued debate about what personal competencies are important for students entering medical school, and what reliable and valid methods should be used in entrance examinations to select students with the greatest potential to become an efficient, professional and caring healthcare professional in the future^{4,1}. The personal characteristics required for admission to health and medical schools are less clear as well as the methods for evaluating their properties suitable for involvement in the selection process. Important characteristics such as coping with stress, motivation and approach to learning are the qualities that seem to be partly predictive of the academic and professional performance of the prospective student³.

People, and their skills and competencies, are the greatest assets of any country. Broadly speaking, skills can be shared for two. Cognitive skills are based on mental ability or intelligence, but like other skills, you can also develop them through learning. Cognitive skills can also be called information-processing skills: these are skills allow one to read, understand, relate different information to existing knowledge. The principal cognitive skills are functional

reading skills, mathematical literacy, and problem-solving skills. Cognitive skills are usually assessed by level papers or final exams in a specific subject⁵. Non-cognitive skills can be largely associated with personal characteristics. Non-cognitive skills, also called professional skills, usually also includes social and emotional skills, perseverance, entrepreneurship, self-efficacy, self-control, self-management, and empathy. The success of healthcare professionals at the moment depends on the ability to work together between and across interdisciplinary healthcare groups effectively and the acquisition of these skills⁶.

The transition to health promotion and the prevention of health problems requires medical and healthcare professionals to meet the different health needs of communities. Medical and healthcare schools have developed comprehensive admissions procedures to be more inclusive in evaluating candidates⁷. Curricula for health professionals face increasing pressure on graduates to succeed in the workplace while meeting the demands of health systems, express a significant degree of motivation (goal-oriented, self-directed), critical thinking (problem solver), emotional intelligence, work-life balance, while meeting core competencies such as communication, collaboration, and ongoing professional development⁸. Among the non-traditional criteria, ethics and reliability, as well as good judgment, was also important as "situational" or "clinical" awareness⁹. The training of such professionals begins with an admissions process where both cognitive and non-cognitive skills and abilities can be screened to identify those with high potential for success⁸. It is important to work to avoid future dropouts during the admissions process, which may result from students' incomplete understanding of the rigour of health care curricula, long clinical hours and stringent requirements in the internship environment⁷.

When applying to medical or health professional programs, the admission interview is considered to be one of the most important, and usually the last, step in the complicated process. Admissions committees also face a significant challenge when planning and managing hundreds of interviews each year, while ensuring that each interviewee is adequately and fairly evaluated. Once the interview is over, the admissions committees may begin to decide which candidates will accept (or not) with the common goal of matriculating those candidates who are the most successful¹⁰. There have been many studies and much research on how the medical and health profession school admission process should adapt to identify individuals with good non-cognitive skills and who will be well suited for collaborative, team-based practice e.g., these studies focus on the interview step of the admission process and emphasize that the interview is the most important part of this process because it provides important information on the suitability and readiness of applicants to study at a school and become good health professional. Almost without exception, all health education schools use interviews with applicants to assess personal characteristics. The characteristics assessed in the typical admissions interview include questions about applicants' motivation for medical careers, compassion and empathy, personal maturity, oral communication, service orientation, and professionalism¹¹.

However, most schools utilize interviews in their admissions process to assess non-cognitive components using a personal interview or multiple mini-interviews methods (MMI)⁹. Studies examining admission criteria for nursing, medicine, dentistry, and pharmaceutical students have shown that academic measures are not the only ones that can predict students' success after acceptance into these programs^{12,9}. Many study results show that interpersonal skills assessed by the interview were inversely correlated with the last years of the program, where more emphasis has been placed on clinical interactions with patients¹³.

Admissions processes during the COVID-19 have not widely studied yet. Only one research report gives information about a technology-based application and suggests that applicants had a generally positive or neutral experience with procedural aspects of the Standardized Video Interview but generally had negative reactions to the interview itself. Applicants also had more negative reactions to highly structured interview and felt that in-person-interview would have "better reflected their proficiency in interpersonal and communication skills and knowledge of professional behaviour."¹⁴. However, technology is increasingly being integrated into health and medical school admissions processes. Moreover, as the COVID-19 pandemic rapidly changes the landscape of medical and health professional education, technology will likely be increasingly used in the admission processes of these schools¹⁵. It can only be hypothesized that interviews, which, even in the previous years, when they were conducted in-person and face-to-face format, raised questions about their objectivity, validity and credibility, have not brought credibility to the web-based technology-mediated format, but rather diminished it.

Characteristics of respondents

The vocational students' admissions survey took place in the period 10.08.2020 - 14.08.2020. A total of 322 candidates were sent a survey. The questionnaire could be answered

online in Estonian and Russian. In the period 12.08, the candidates could also answer the survey on the spot in the Tallinn study building (this opportunity was used 9 times in total). On 11.08-12.02, the candidates had the opportunity to answer the survey on-site in the Kohtla-Järve unit building (this opportunity has been used a total of 40 times). A total of 117 candidates for vocational training responded to the questionnaire, of which 115 were women and 2 men. 46 respondents applied for the Kohtla-Järve study group and 71 for the Tallinn study group.

The applied higher education students admissions survey was conducted in the period 8.07.2020 - 17.07.2020. A total of 1347 candidates were sent a survey. The survey was answered online in Estonian (382 respondents), English (3 respondents) and Russian (173 respondents). In the period 13.07-14.07, participants in the entrance examinations for the dental technician curriculum also had the opportunity to answer on paper (this opportunity was used twice). A total of 558 student candidates admitted to the admission exams responded to the applied higher education feedback survey. 511 of the respondents were female and 47 were male.

The survey of candidates for master's studies was conducted in the period 8.07.2020 - 17.07.2020. A total of 104 candidates were sent a questionnaire. The survey could be answered online in Estonian. A total of 60 people responded to the survey, including 55 female and 5 male student candidates.

The majority (62%) of those applying vocational education indicated Russian as their daily language of communication. The daily language of communication for candidates for higher education is predominantly Estonian (56.9%), followed by Russian (41%). There were significantly fewer speakers of other languages on a daily basis. All candidates for master's studies filled the questionnaires in Estonian. At the same time, 27% of them stated Russian as their home language.

The majority of those applied for vocational education were in the age groups 41-45 (24%) and 51-60 (20%), followed by the age groups 18-20 (14%) and 31-35 (13%). More than half (52%) of the candidates in higher education who responded to the survey belonged to the age group 18-20, other age groups were already relatively modestly represented. The age groups 21-25 (12%) and 31-35 (10%) can also be mentioned. The respondents who applied for master's studies were the most in the age groups 31-35 (22%), 41-45 (22%) and 26-30% (18%), but the age representation of the candidates was limited to the age groups 21-25 and 51-60.

The previous field of activity of candidates for vocational education was already closely related to health and social work (36%). Fewer candidates came from the service (18%) and education sector (9%). 11% of respondents were not working at the time of admission. Candidates for higher education come mainly from the service sector (33%), but also the health and social work sector (18%). 11% of respondents did not work before the entrance exams. 97% of candidates for master's studies in health sciences come from the field of health care and social work.

Admissions process

The four most important factors that encourage candidates to choose a College were a suitable profession, the opportunity to find a job in this field, a large share of internships, proximity to home, modern study conditions and an international diploma.

Respondents received initial information about the College through the College's website and from friends and acquaintances, as well as from their working place. The fact that the workplace is an important information source for candidates confirms the previously acknowledged fact that many of those applying for College already work in the field of health and social work.

The College does not need a lot of promotion. COVID-19 made it clear that health care professionals are really needed - in addition to doctors, the focus was on nurses and care workers, but also pharmacists and others. When we asked what specialities (including other vocational, higher and university institutions) entrants were still considering, it turned out that this time the candidates of Tallinn Health Care College had thoroughly considered the matter and almost all options were related to health care and/or medicine - 50% of vocational education candidates, 38% of higher education candidates and 30% of master's degree respondents did not consider any other speciality or higher education institution.

Student candidates took the admission exams with all seriousness and showed a highly responsible attitude for admission tests (Figure 1).

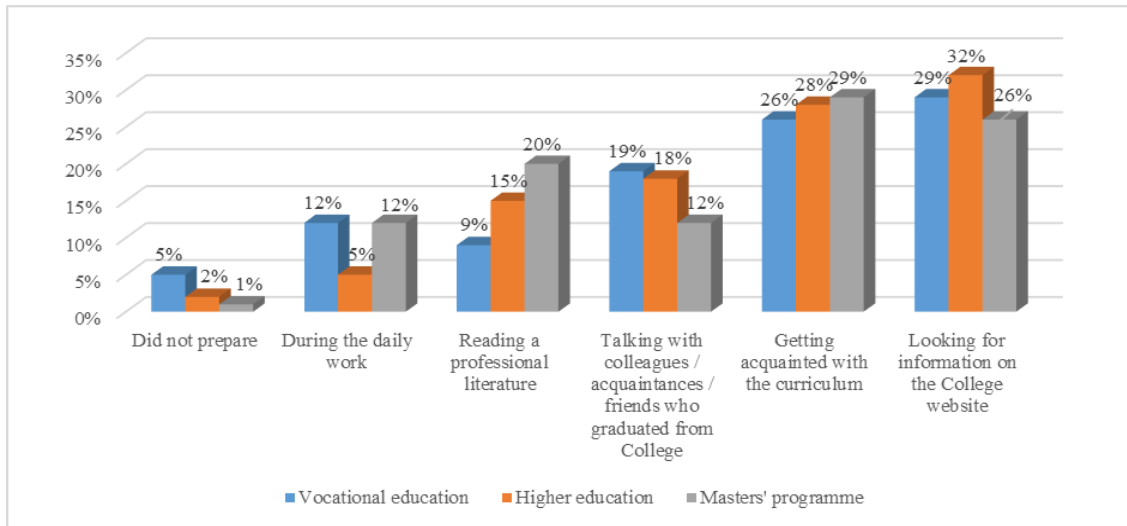


Figure 1. Preparing for admission

The adequacy of available information on the syllabus applied and admission examinations were included to the scored relatively high - 87% of respondents who applied for vocational education, 85% of respondents who applied higher education and 90% of respondents who applied for master's programme considered the information sufficient (Figure 2).

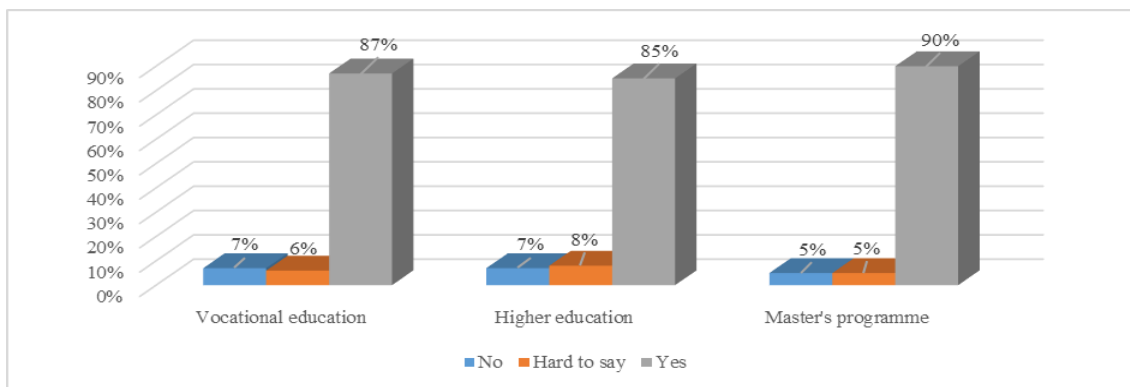


Figure 2. Satisfaction with the availability of information during the admission

Although Figure 2 shows the fact that the satisfaction rate with the availability of information was high among all education level candidates, a large number of comments suggested improvements to the communication. Candidates expect information on the different steps of the admission process to be easier and more systematic to find from the College's website, more information days and/or information question hours, even the preparation courses have been considered necessary. They want to know how long the admission interview will be. Information is also expected on the future study organization plan – e.g., on which days and hours the lessons will take place, etc. And yet, surprisingly, information is sought on how many students will be accepted to each curriculum. Master's students would like to know more about what exactly should be included in the submitted development project plan.

Vocational education:

- *The preparation courses are necessary.*
- *An information question hour for applicants would be necessary.*
- *Before starting an interview, it should be definitely to know how much time you have.*

Higher education:

- *I think it is worth organizing more information days.*
- *Information is sometimes chaotic on the website*
- *Indicate on the website the number of study places in each curriculum so that entrants can calculate the probability of admission themselves*
- *A little more information about the future lesson plan/study organization could be available*

- *It would be good if the website had information that, for example, when entering the dental technician profession, the experience of working in a laboratory is important.*
- *The website could be more systematic in order to find the necessary topics in a timely and fast manner.*
- *The number of study places could be on the website.*
- *More information about the admission interview and how to prepare and what topics to focus on*
- *To provide more information on what to be expected in the admission tests, because it is difficult for Russian-speaking people to orient themselves in Estonian-language tests of difficult subjects.*
- *Would like to have better information about the organization of studies. For example: What time do classes start and end? What days the study takes place and where? Then it would be better for the working person to plan their work before starting studies.*
- *The website must contain information on how many students are admitted to the speciality.*
- *I did not find information on how many people are admitted to the profession. I searched and searched, but unfortunately, I couldn't find it.*

Masters' programme:

- *I would like more information about the development project concept, the structure of the work.*
- *The information question hour was very useful.*
- *Finding information was easy.*
- *All the necessary information was available on the school's website and posted earlier so that the candidate could get acquainted with the information and prepare for it.*

Satisfaction ratings for the admission process were asked on a 5-point scale from 5 – highly satisfied; 4 – satisfied; 3 – rather satisfied; 2 – hard to say (neutral); 1 – highly dissatisfied. Figure 3 shows that the satisfaction of vocational education applicants with the admission process is the highest. The admission process was largely satisfied or very satisfied with the various parts and also in general. They were particularly satisfied with the organization of the reception of documents (4,46), as well as with the work of the admission committee (4,33). There is a slight criticism in the evaluations of the participants in higher education admissions for the different parts of the admission process. Looking at the scores of the different steps of the admission process and as a whole, it can be stated that the candidates who applied for higher education level were more satisfied with the organization of the receipt of the documents (4,35) and with the admission process comprehensively. The master's programme applicants were mostly satisfied with the organization of the reception of the document (4,4) and with the work of the admission committee (4,15).

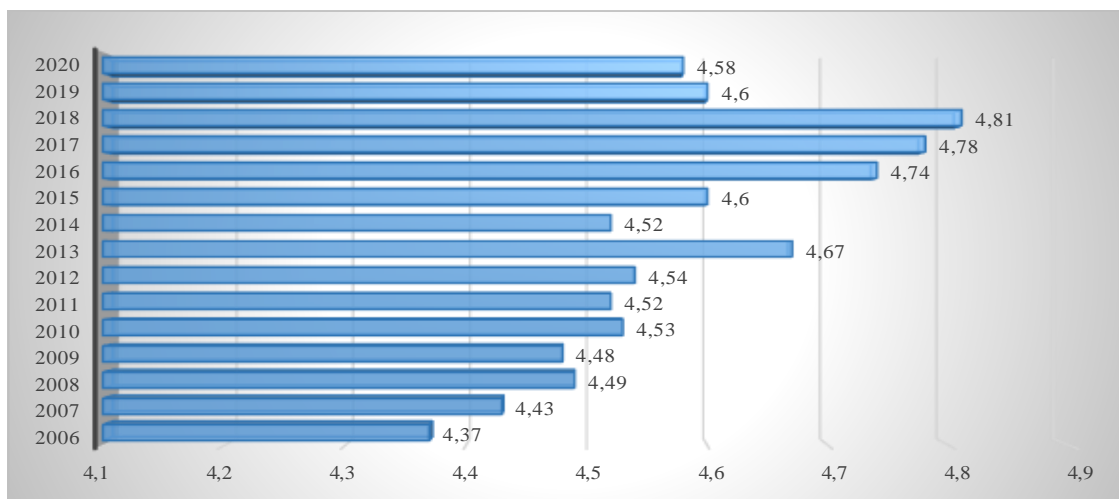


Figure 3. Ratings for the satisfaction of different steps and the admission process comprehensively

Feedback on the organization of the reception of documents has been sought since the first feedback survey in 2006. This part of the admission process has been one of the most controversial over the years. Although satisfaction with the process of receiving documents is significantly higher among candidates than in other parts of the reception process, it is

considerably lower compared to the satisfaction rating in the intervening years. As presented in Figure 4, satisfaction has fluctuated widely since 2006 when feedback on the receipt of documents was first requested. In 2020, satisfaction with the organization of the reception of documents has dropped to the same level as in 2006. In the intervening years, the estimates have been significantly higher, especially in 2010 (4.72), 2013 (4.76) and at a record level in 2017 (4.84) and 2018. (4.82). While in 2006 the documents were still received at the school on the spot, in 2009, documents could already be submitted both on the spot and online via the SAIS. SAIS had some limitations - there were many who could not submit documents and were happy to take the opportunity to submit their documents directly to the school. In the summer of 2020, this was not an option - everything had to be submitted online. It is possible that this was the main reason why the scores for the organization of receiving documents decreased slightly.

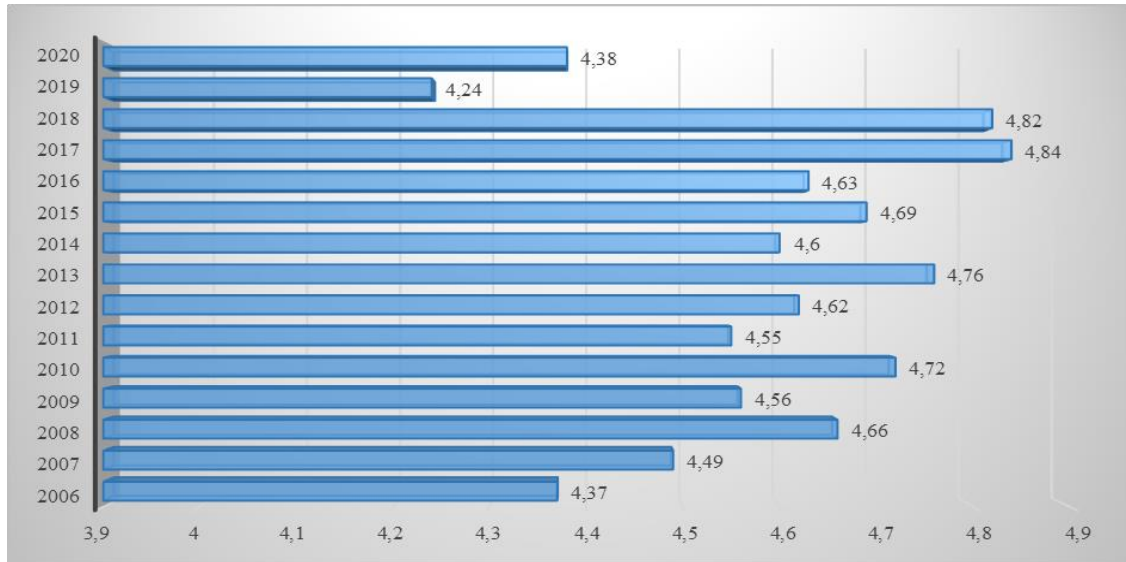


Figure 4. Satisfaction with the organization of the reception of documents 2006-2020

When comments from 2006, 2007, 2009, and also 2011 were included, complaints about the long waiting in queues and tired receptionists arose, and there were also complaints beginning in 2009 about the lack of experience, knowledge, and instructions of how to submit documents electronically:

- *We had to wait in line for a very long time.*
- *When I arrived on the spot, the documents were not accepted and I was told to apply them online. So, I drove a total of 300 km pointlessly because I can't do all the necessary things online.*
- *Apparently, the reception girls were already tired and nervous enough when I came with my documents on the last day to College.*
- *The SAIS system was complicated, it couldn't handle itself. I had to send the documents using the help of other people for this purpose.*
- *On-the-spot reception of documents was in high queues.*
- *The documents required for admission could also have been sent by e-mail (if not applicable to apply in SAIS).*
- *I had to personally deliver documents requiring education.*

In 2020 the comments about the organization of reception of documents were highly supportive:

- *Everything was at a high level. Everything was clear, concise and understandable. When there were questions about submitting documents online (Sais), there was always an answer on how to do everything correctly.*
- *All the necessary documents could be submitted through a computer and did not have to be uploaded separately.*

Since 2013, feedback has also been asked on candidates' assessments of the work of admissions committees. Figure 5 shows that ratings have fallen over the last two years, but the valuable comments added have been carried with a more positive attitude as the negative one from applicants at all levels, although it should be admitted that the higher education applicants showed more criticism than other education level candidates.

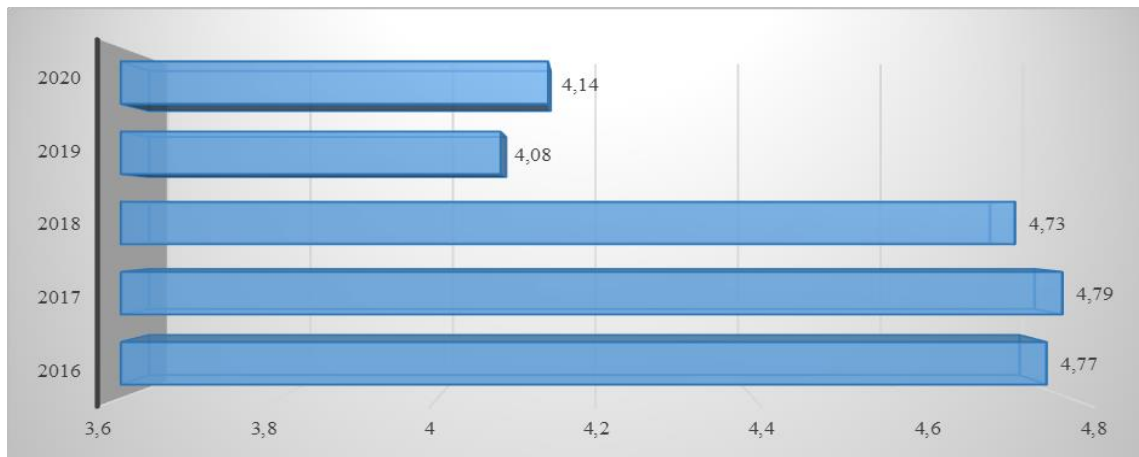


Figure 5. Satisfaction with the work of the admission Committee

Vocational education candidates appreciated the admission committee's friendly and open attitude and the members' skills to make a calming atmosphere to applicants:

- *Pleasant communication with educators during ZOOM interviews, very attentive and friendly people.*
- *The attitude of the admissions committee, nice and friendly women. I don't know if I got in or not, but thanks to them anyway.*
- *The members of the Committee were competent in their work, very attentive and understanding.*
- *Professional approach. The conversation was not very strictly formal - it helped not to get very nervous. Thank you!*
- *Pleasant and friendly atmosphere. Clear and understandable questions. There was an immediate interest in the candidates for further joint cooperation. Thank you!*

Higher education students highlighted the professional attitude and relevant questions asked. They also valued that they had an opportunity to explain why they choose the specific subject and how they are planning to manage their life during the studies.

- *I liked the interview the most. The admissions committee was very friendly and kind. The questions were relevant, understandable and not difficult. It was, above all, a conversation, I did not have any fear or anxiety.*
- *I liked the interview in Zoom because the Committee was friendly, professional, sympathetic, kind and humorous. The questions were dignified, not very difficult. I liked that during the conversation I had the chance to explain my choice of speciality.*
- *Admissions Committee - very nice and pleasant people, although I shuddered, I felt comfortable due to their positive energy.*
- *Warm and good atmosphere, I realized that the commission believes that I want to become a nurse and listen to why and where this decision came from. I liked everything.*

However, the higher education candidates were more critical than other candidates and pointed out that the interview could have started with a mutual introductory part, which would also help to reduce the candidate's tension. The applicants liked the questions related to the speciality. It was some amazing about personal questions, such as where the student gets the money to commit to learning or how he or she intends to combine school and work.

- *A small introductory section to relieve tension.*
- *The admissions committee could also introduce itself during the admission tests.*
- *Members of the Admissions Committee could be more polite.*
- *The Admissions Committee should not underestimate or ridicule the sense of mission or the desire to improve the world.*
- *The members of the admissions committee could be more positive, cheerful and motivating.*
- *The Commission did not introduce itself. The interviewer hurried after the conversation and did not let me end my sentences. The required task was also interrupted before the scheduled 5 minutes. All in all, it seemed as if there was no time or interest in me as a candidate to delve deeper.*
- *The first half of the conversation was very positive: why do you come to study, which field of study? The other side caused confusion. With questions like where do I get money or who pays for my lifestyle, how do I plan to go to work, there is no relevant content for making such a short appeal and getting to know the person.*

- *Introducing questions to start a suitable conversation is relevant.*
- *The Committee could ask more professional questions during the interview.*

Master's programme candidates were waiting for more professional rather than general questions and also highlighted the missing introductory part:

- *The Committee was friendly, helping to ease tensions.*
- *Positive admissions Committee.*
- *Calm and supportive attitude.*

• *In the Zoom environment, it was not clear with whom the conversation took place. Not introduced. No chat time specified. Chat timed out. The pace was fast and the answers to the questions were not heard to the end.*

• *General questions were asked during the interview. Unfortunately, this does not necessarily indicate the candidate's communication and analysis skills. Also, getting acquainted with the curriculum and naming the subject modules that have aroused interest does not indicate whether the candidate is suitable to study in the chosen field.*

Feedback on the admission format was asked from 2013 onwards. There are comments from the 2014 feedback survey that characterizes well the difference between then and 2020: *Everything was very good :) But it would be better if the College can arrange the admission process the way that there is no need to travel to Tallinn three times for three different reason – for a test, for an exam, and finally for an interview (and for 9 o'clock in the morning!) and The admission could have been arranged on consecutive dates or even same day to make things faster and more convenient for applicants.*

As we can see from the Figure 6, the 2020 admission format has brought the highest score - 4.81. This shows that even though many candidates did not like the online interview and doubted the objectivity and reliability of the results of the technology-mediated admission test performed from home or work, the full introduction of the online admission brought unprecedented convenience, outweighing some technical problems and moments of confusions on the web.

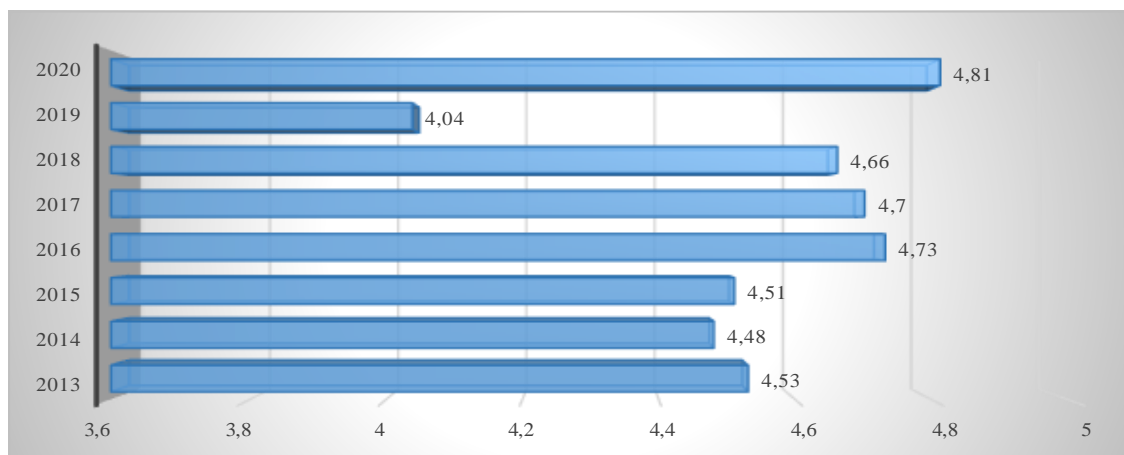


Figure 6. Satisfaction with the format of the admission test and interview

Vocational education candidates were more critical of online admission interview than others, in their opinion it may not give the right or adequate impression of the candidate. Candidates also felt that the interview was too short and should be longer.

- *The time limit could be higher for interview.*
- *The interview should not certainly take place via the Internet; more questions should be asked to determine suitability for the profession.*
- *Since I had not used Zoom before, it was a new option for me, but more convenient.*
- *Everything was high quality, clear, concise and understandable. When questions arose, there was always an answer on how to do everything right.*
- *I liked the admission organization you currently have.*
- *More free communication, so it is not inconvenient to be at the interview.*
- *Would like a long conversation during the admission interview to better introduce myself and my desire to learn.*
- *The interview should not be held via a computer.*

Higher education applicants' feedback is divided into two when commenting on online admission. Some are very enthusiastic about the new format and want it to continue. Applicants

were satisfied with the remote format of the whole admission process and their main suggestion was that remote admission is here to stay. The other part wants the tests, exams and interviews to take place in the traditional way:

- *I liked the admission arrangement. I think it was convenient for all parties and at the same time new and interesting.*
- *The admission process was performed at a higher level. I am very happy with both the test and the conversation. Everything was very clear, understandable.*
- *I really enjoyed taking the exam online because I had a working day that day. This means that I agreed with my colleagues and went to lunch at a time that suited me. I didn't have to waste time driving there and back. Thank you!*
- *Whenever possible, face-to-face and a professional environment where technical details are pre-checked and exams/tests/conversations run smoothly.*
- *The interview could have taken place face-to-face and on-site, in order to avoid the technical problems that arose.*
- *The Zoom environment was not convenient for me because I am afraid of the camera*
- *I didn't like the admission interview because of the Zoom, but I understand why it was moved there.*
- *The reception interview in Zoom was about 25 minutes late. Scheduling can be improved.*
- *It was very inconvenient to participate in the interview online, as direct contact works better in such a situation. Even during the coronavirus, interviews and entrance exams were conducted on the spot in some universities, which undoubtedly improves the quality of the results. An online chat can lead to a misunderstanding of the candidate because there is no direct contact.*

Candidates for the master's programme valued their time and were most satisfied with the admission process format. Also, it seems that master's programme applicants are generally more confident and familiar with new technologies:

- *Got all the necessary actions without going to school*
- *Everything was held via e-environment. There was no need to get there.*
- *Admission interview did not have to plan time to go to school separately and did not have to take time off work, it was very convenient to take a break from work and take part in the interview.*
- *The conversation took place in Zoom. I didn't have to take a day off and it was therefore a time saver.*
- *Opportunity to apply from a distance.*

The comments on the tests mainly included the concern of how the College checks that the test has been taken by the candidate himself and without outside help.

- *Admissions still need to be checked by the school because you never know who helped the candidate take this test. Not fair.*
- *Receptions could be arranged with a camera (e.g., Zoom) so that there is no risk of someone talking or taking the test.*
- *While the tests are being done, someone should also make sure that the right person is solving the test. Monitoring during the test, as the performance time was quite long*
- *However, the test should be performed under supervision.*
- *I think that the results of the online admission tests are not objective, because there is no way to check how honestly the entrant passed the tests and whether he/she passed them independently.*

Candidate suggestions for further admissions

The last questions gave respondents the opportunity to make suggestions for better reception and to indicate what they liked most about the reception tests.

Applicants highlighted that while this may save the admissions committee time, group chat was not considered a good solution, entrants would have expected a more personal approach. It was also assumed that the interview would be longer, which would have given the candidates more opportunities to prove their motivation and readiness to study:

- *I think the group chat 20min is a bit short.*
- *The group interview is unpleasant because some interviewees are distracting others.*
- *Have an interview with one person individually, not to take 3 people at a time.*
- *The duration of the interview was too short for me. I think it is very difficult to decide the person's suitability for the profession chosen during this time.*
- *I was prepared for more in-depth professional questions, but the conversation was very short*
- *More in-depth interviews, more questions.*

In conclusion, it can be said that mostly a pure positivity was expressed in the assessments and comments given to the admission process:

- *At the moment the admission process is well structured, all information was available*
- *As I am satisfied with the organization of the admission process, there is nothing more to add.*
- *The best experience so far.*
- *Continue in the same direction.*
- *Despite a different situation, this year's reception was well organized.*

Conclusions and discussion

Healthcare and medicine are complex and evolving fields, and professionals working in related fields must have not only the practical and academic knowledge and skills acquired at school, but also the personal qualities suitable for the job, such as critical thinking, communication skills, teamwork, empathy, cultural sensitivity, ethical decisions, self-evaluation, and self-control, etc. Schools involved in the training of future medical and health professionals have a responsible task - how to recognize future motivated and learning students who want to contribute to the development of their profession, and those who enter the labour market as highly qualified professionals, during the admission process.

Much research has been done to investigate what a perfect admission process should look like. At the same time, there is a lack of in-depth research on what candidates themselves think of this whole process. Such research and feedback surveys should be carried out more, and also shared with the public so that all higher education institutions in the medical and healthcare fields can improve and enhance the admission process.

The current article was based on a feedback survey of applicants conducted in the summer of 2020. The satisfaction of candidates in vocational education applied higher education and master's programme with the admission process was examined. Since for many, health and medicine are a speciality or field for those of a slightly later age, we wanted to find out which fields the entrants come from. In addition, the aim of the survey was to find out the reasons why Tallinn Health Care College was chosen for study, with whom the candidates discussed their choice before the admission process, which speciality was preferred, and what factors influenced this decision. They also wanted to know from which source information about the school was obtained, and what questions-doubts arose in the process of choosing a school and speciality. Some results were compared with the results of previous feedback surveys, if available, and the available data was presented by year. However, it should be mentioned that the survey has changed a lot over the years, and the possibility of comparison was opened only for a few satisfaction indicators.

The candidates chose Tallinn Health Care College mainly because of the suitable profession and the opportunity to find a job in the chosen field. The most important source for obtaining the information about College and speciality chosen before admission as well as for preparing for admission tests, exams and interview, was College's website. Satisfaction with the availability of information during the admission has decreased during 2019 and 2020 compared 2018, 2017, and 2016. The main reason was the difficulty of finding relevant information from the complex structure of the website. It was also suggested that the college should organize more preliminary information days/hours, and that there should be more information about the organization of studies after admission. Satisfaction with the reception of the documents process dropped in 2020 to the same level as it was in 2006. This fact needs further investigation considering that the comments on the process of receiving the documents were very supportive and impressed high satisfaction.

As highlighted in the conducted literature review, the admissions interview is considered one of the most important and usually the last step in the complex process of applying to medical or healthcare programmes. Adequate and fair assessment of each interviewee is the most important challenge for admissions committees when planning and conducting hundreds of interviews. Can this process be considered a success through the web? The candidates highly valued the Admissions Committee's friendly attitude and relaxed atmosphere, although more specific questions, and not so many related to personality, were expected. However, the technology-mediated group interview was probably not the best choice for an admission interview and this fact was also highlighted in the comments. The candidates' suggestions also included to extend the admission interview time (to spend more time on one candidate).

If in previous years, candidates complained about the need to travel to Tallinn or Kohtla-Järve several times for documents application, tests, and interviews, then this year there was no such concern - admission was 100% technology-mediated. Most applicants welcomed the new opportunity and appreciated the convenience of taking a test and interview from home or work

without spending money to travel. The others were not feeling comfortable and would have preferred a face-to-face interview.

Most of the candidates could not make suggestions for improving the organization of admissions. Everything was fine and they were satisfied with everything. There were a few suggestions: to increase the number of study spaces, to add more systemized information about the speciality and admission process to the website.

The authors of the current study hope that this article will encourage other health care educational institutions to share their admission feedback surveys and that way it is possible to compare experiences and learn from candidate feedback mutually. The shared admission feedback studies gave an opportunity to analyse whether the educational institution has done its best to support and inform candidates during the admission process; built online tests that do not raise questions about the reliability of how independently they were performed by applicants and that the tests would not be too easy or too difficult to settle; be prepared to provide faster feedback on the results of admission stages. Although there are several applicants to be interviewed and time is limited, to set up by professionals and lecturers an interview that runs smoothly and leaves enough time for candidates to introduce themselves and talk more about their preferences and speciality chosen. The interview structured in this way also ensures that the admissions committee has a sufficient understanding of the interviewee's characteristics and suitability as a future health care professional.

Non-cognitive characteristics can be evaluated face to face interview, a tool that has been considered important in the selection process. However, interviewers must be properly trained. Candidates should certainly have been informed that if their academic and learning ability has already been established based on high school diplomas and tests and trials, the interview will focus on whether the applicant's personal qualities are suitable for a tense curriculum, plenty of practice, and group work. However, it is also the responsibility of the admissions committee to ensure that all students admitted become not only excellent health care professionals but that they have the appropriate qualities, such as friendliness, helpfulness, teamwork skills, and patient-centeredness.

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GETTING TO KNOW FUTURE SPECIALISTS WITH INNOVATION: THE CASE OF ŠIAULIAI STATE COLLEGE

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Annotation

The article presents a study of future professionals' knowledge of innovation. Šiauliai State College I-IV-year students formed the research sample group. 103 respondents took part in the survey. Students usually get acquainted with innovations from the press, via the Internet, Youtube channel or social networks, as well as during college lectures. Research has shown that students are best acquainted with technological innovation and the stage of generating innovation ideas. The higher education institution should strengthen the studies of other stages of innovation development, especially commercialization.

Key words: *Innovation, acquaintance with innovations, STEAM, Šiauliai State College.*

Introduction

Innovation is identified as a priority both in public life and in the state and inseparably in private business. Every entrepreneur strives to constantly improve the performance of his company in the market in order to take a leading position in the competitive struggle. Reducing costs alone is not enough to win, it is important to think about growth, added value, which can only be achieved through the use of knowledge and the development of innovation processes. There are many breakthrough inventions in Europe, but Lithuania unfortunately is not among the leaders in this regard and ranks only 40th in the global innovation index. The state needs to look for new solutions by supporting and promoting the development of innovations, strengthening the existing positions of business in those development processes that have a positive impact on the Lithuanian economy.

The European Innovation Scoreboard (2022) shows that Lithuania is one of the countries implementing the most innovations in the European Union in the last 7 years. Lithuania's aggregate innovation index has risen to 92% of the EU average in 2022. This compares with 72.1% in 2015 and 85.6% in 2021. But some indicators of this index, such as employment share knowledge-intensive services, high and medium high-tech knowledge sharing and use of information technologies, do not reach the average of EU countries and have not shown the necessary progress in recent years.

Innovation is based on the creativity of employees, knowledge of technologies in a specific field and entrepreneurship. At present, students of Lithuanian education and research institutions are taught these knowledges using innovative teaching methods, such as project activities, but the innovations themselves are often very fragmented for future professionals. It depends on the opportunity to visit the businesses that initiate, develop and implement those innovations. Also, from the environment in which they live and what sources of information about innovation they can access. The topics of innovation in curricula are usually not directly included in the subjects of secondary education schools, it all depends on the teaching methods used by teachers. However, students have the opportunity to participate in a variety of complementary activities, such as STEAM (Science, Technology, Engineering, Arts and Math), which contribute to a better understanding of innovation. Students' cognitive opportunities are further expanded when they choose to study subjects related to innovation through production practices and internships and engage in innovation-creating projects. However, their participation in these activities depends both on their personal goals and on the opportunities offered by the higher education or other educational institution.

In the research it was important to find out how high education institution students as future specialists get acquainted with innovations and get involved in innovation development activities.

The goal of the research is to find out how students get acquainted with innovations by interviewing students of the Faculty of Business and Technology of Šiauliai State College.

Research objectives. The article first reviews the concept of innovation and the possibilities of cognition of innovation from the theoretical point of view. The research methodology is discussed below and the research results are presented. It was determined how and which innovations students know best.

Research methods are the following: theoretical, empirical analysis, questionnaire, descriptive statistics, classification and generalization of data.

The concept of innovation

Innovation is a new or substantially improved product or process including production, construction or other processes, new marketing methods, new business, workplace organization or external communication methods introduced to the market, public administration, social, cultural field. It is important to know that the word “innovation” is derived from the Latin verb *Innovare*, meaning “to renew” (Strazdas, Bareika, 2010). In everyday communication, innovation is often referred to as “novelty”. Innovation means the updating, improvement and development of a process or product, which can also be a service. One of the most popular Hauschildt (1999) model in the scientific literature (Garcia, Calantone, 2002; Murswieck et al, 2017) distinguishes four levels of innovation:

- *Incremental innovations*. Improving an existing idea (goal) using existing methods. The degree of innovation is very low, because existing products, processes or business models are made with only minor changes.

- *Goal-driven innovation*. A new goal emerges which is achieved through unchanged or new measures. Activation of innovation is often driven by customer needs or market demand. The degree of innovation in this case is average.

- *Medium innovation*. New measures are proposed to meet existing or new targets. Medium-sized innovation is mainly based on the company's R&D activities, which often have a higher degree of innovation compared to the innovation brought about by the new goal.

- *Breakthrough innovations*. These innovations are particularly characterized by the fact that the unknown need of the customer is met by completely new means or by applying new technology. Breakthrough innovations show a very high level of innovativeness and are innovations that undermine established production (service provision) principles.

Different types of innovation are possible:

- Improving processes by constantly developing new solutions and organizational innovations.

- Product development: the development of innovative products or product features.

- Service innovation: development and implementation of new services for customers and partners.

In research, innovations are classified according to the functional areas they affect (see Figure 1). However, a more general classification of innovations by content, user impact and visibility is also possible:

1) *a product innovation* is one that is characterized by a new product design, innovative performance or meets new customer needs and is usually visually recognizable. This innovation can vary in scope from a completely new product (service) to a small improvement that gives the product (service) new features.

2) *technological innovation* is components, component relationships, production or service delivery methods, processes, combinations of those methods or processes that are applied to the production of products or the provision of services, based on new knowledge in various fields (engineering, management, etc.). This type of innovation is often closely related to organizational innovation which according to S. Pogosian and I. Dzemyda (2012) is a change that can take place in marketing, purchasing and sales, administration and personnel management policies.

3) *social innovation* is defined very broadly and not unambiguously in the scientific literature, but Vveinhardt and Kuklytė (2016) perhaps best describe it stating that “It is the development of social and economic well-being, representing the principles of traditional entrepreneurship, economic profit, social needs (motives)”. These innovations range from new models of social service delivery to specialized online social networks, from new forms of student training or staff development to measures to encourage people to switch cars to bicycles or the creation of global fair-trade networks.

Functional areas innovations affect	
<i>Content</i>	Organizational, social, technological
<i>Level of implementation</i>	Scientific, technological, engineering, industrial
<i>Extent of implementation</i>	Single, multiple
<i>Speed of innovation</i>	Fast deployment, incremental deployment, slow deployment
<i>Extent of innovation</i>	Local, regional, international
<i>Efficiency</i>	High, stable, low
<i>Impact</i>	Economic, social

Fig. 1 Classification of innovations

Source: compiled by the authors based on A. Maziliauskas (2017), B.Čėsna (2011)

Researchers distinguish between 5 and 11 stages of innovation creation (Česna, 2011; Kogabayev and Maziliauskas, 2017; Banelienė et al., 2020), but the most frequently mentioned are:

- Generation of ideas and development of innovation concepts;
- Designing;
- Production of a test sample (prototype);
- Testing and improvement of the test sample (prototype);
- Presenting to users the manufactured, fully prepared innovative product, technology, system, method;
- Commercialization;
- Production start-up.

Providing the necessary resources, team collaboration, and good relationships with the end user have the greatest impact on innovation. Important are those details that turn the original idea into a completely attractive product for the end user. Innovation is very useful for companies to differentiate themselves from their competitors. In other words, value creation is an essential characteristic of innovation. Today's business is challenging to survive in the market because the supply covers a very wide range of the market, so companies need to innovate to create unique competitive product features. Such products usually have their starting point in a barely recognizable niche and initially appeal to only a small number of customers until they become a dominant market factor and push other previously developed products and often the companies that produce them out of the market. Innovation management and implementation models are developed in business enterprises or other organizations the result of which are new products and services for future markets or society. Innovative business models are emerging - start-ups, business transfer models that create added value by creating new knowledge and implementing innovations as well as implementing them in practice. In the future such business models should appear which are not even possible to imagine today. Small teams able to operate flexibly will develop innovative concepts from innovative product idea to its maturity in the market.

Opportunities to learn about innovations

The aspect of acquiring knowledge about innovations has not been sufficiently studied in the scientific literature (Donate, Guadamillas, 2011). As stated by Girnienė (2014), organizations often lack systematicity and expediency in managing knowledge, an open environment that promotes employee trust is not created, when employees willingly share knowledge and acquired experience. Sometimes, knowledge acquisition is still understood very narrowly, only as the learning of its members, ignoring the possibilities of organizational learning (Balvočiūtė, 2007). However, more scientific works are emerging in which innovation is analyzed in the context of knowledge sharing and management (Atkočiūnienė, Petronytė, 2018), but empirical studies are rarely carried out.

One of the ways of learning about innovations is STEAM activities carried out in preschool institutions, secondary, vocational schools, colleges and universities. STEAM education - integral education of students' abilities in the context of natural sciences, mathematics, technology and engineering which focuses on the complex knowledge of reality phenomena, application and problem solving (Šlekienė, 2018). Based on research related to the evaluation of STEAM activities (Hidi & Renninger, 2006; Hidi & Ainley, 2008; Dorph et al., 2017) it can be said that participation in STEAM activities is an important factor for young people to choose a professional career related to technical, engineering sciences. Creativity and technical creation as an interdisciplinary approach is emphasized in STEAM education, rationally combining it with the peculiarities of individual educational subjects. Many Lithuanian secondary and higher education institutions are involved in STEAM activities, but these activities do not always include innovation. Sometimes learners simply get acquainted with the basics of applying engineering sciences in practice or participate in some stage of innovation development. On the other hand, not all educational institutions have the opportunity to participate in these activities.

Cooperation between science and business is another activity that helps to get acquainted with innovations. These projects financed by the structural funds of the European Union and usually initiated by business enterprises are intended to involve scientific and study institutions in the creation of innovations. These activities aim to develop student training, research and business in the direction of innovation. However, this cooperation has a number of problems such as the small scope of activities of scientific and business entities, the small number of products created by new knowledge and commercialized. Joint projects usually involve only researchers, not students. Insufficient funds are allocated for student training or

they cannot fully engage in business and scientific cooperation activities due to a very intensive study process.

Another opportunity for students of vocational and higher education studies to get involved in the knowledge of innovations are production practices and internships. However, even here, students have very different opportunities, since internship companies have different experiences, opportunities and unequal conditions they can offer to get acquainted with innovations. Students who carry out semester or research summer internships while participating in projects initiated by the Research Council of Lithuania and other institutions supported by European Union funds and dedicated to these activities can be most actively involved in these activities. However, the funds allocated for the implementation of these projects are not large, and in addition, few students from one institution can join the projects. The quality of scientific research or practice also depends on the conditions created by the company and the extent to which a researcher or intern can directly engage in the creation or implementation of innovations in the company.

Research methodology and results analysis

Methodology of research. The research was conducted at the Šiauliai State College from March 23 to April 23, 2022. The research instrument - an anonymous survey questionnaire (<https://apklausa.lt/f/ar-esu-susipazines-usi-su-inovacijomis-l3req1/answers/new.fullpage>) was composed of five closed type questions - two of them were demographic questions, the other three - related to knowledge of innovations according to their types, knowledge circumstances and stages of their development. In order to find out which innovations (according to their three types) were most remembered by the respondents, one open-ended question was presented. The questionnaire was placed and the link was sent to the respondents using the website www.apklausa.lt. Targeted selection was applied in the study - students of the Faculty of Business and Technology were chosen, who during their studies at least get acquainted with innovations from a theoretical point of view. 135 questionnaires were sent, 103 were returned. Questionnaire return rate - 76 percent. Data analysis was performed by calculating averages and comparing the opinions of students of individual study programs, distinguishing the main circumstances and methods of getting to know innovations, the types of innovations that students got to know best.

Analysis of research results. Almost half of the students are representatives of business and public management, almost a third – engineering, a fifth – social sciences and a tenth – informatics, it was determined after performing the analysis of the demographic data of the respondents who participated in the study (see Figure 2). Such a distribution of respondents corresponds to the structure of all students studying at the faculty according to study programs.

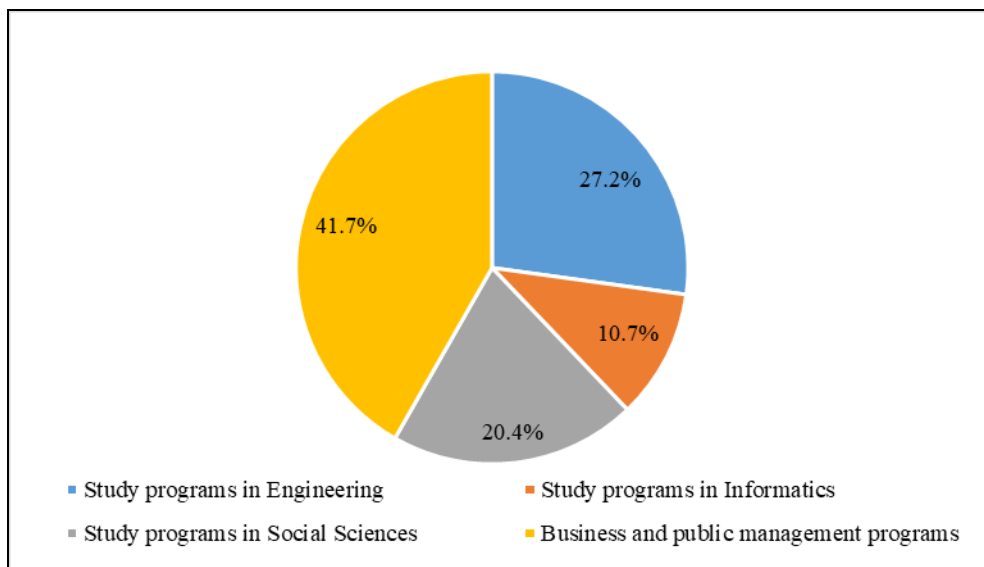


Fig. 2 The study program in which the respondents are studying.

Most of the interviewed students are studying in higher courses (about 75 percent) and only a quarter are in the first year. Internships start in college in the II year and continue in the III and IV years, so it can be said that most of the respondents already had the opportunity to get acquainted with innovations during the internship.

It can be assumed that nowadays it is not difficult to get acquainted with innovations, because they are found in many areas of our activity: at home, at work, in the science, etc. However, after analyzing the students' answers to the question of which innovations they are familiar with, it was found that only a little more than a third (36.6 percent) of the students had already gotten to know technological innovations, 24.2 percent of respondents answered that they already know about product innovations, a fifth - about social innovations, and 18.6 percent. respondents answered that they do not know what innovations are and did not have the opportunity to get acquainted with them. (see Figure 3)

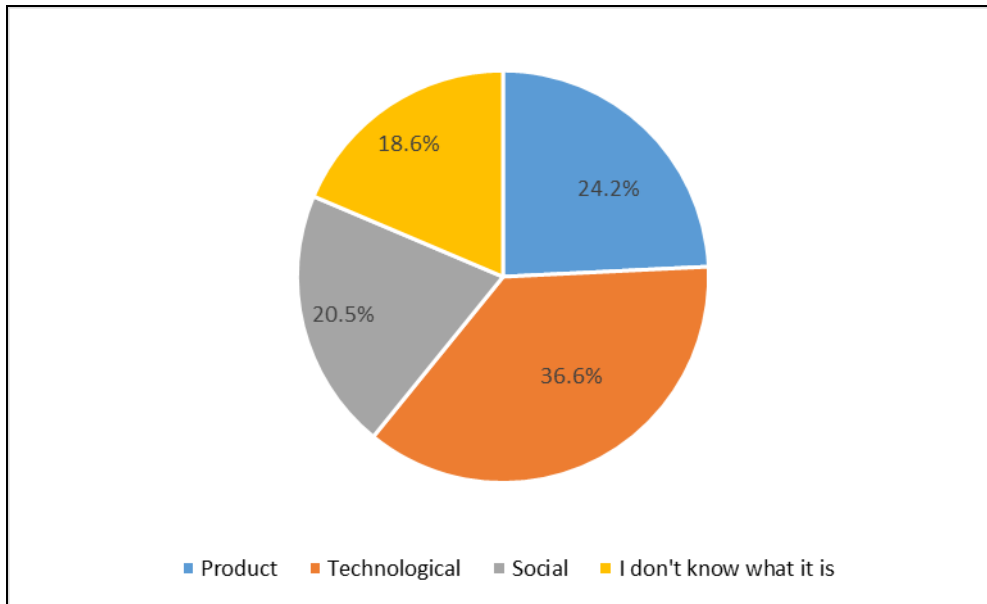


Fig. 3 Students' acquaintance with innovations according to the type of innovation

The respondents got acquainted with innovations in different ways and under different circumstances. 10.6 percent met some of them while studying at school, during field trips to companies. Less than a tenth (8.4 percent) got to know about it from the stories of relatives or friends. Another smaller part got to know innovations while working in companies before studying. Almost a fifth of the respondents - in the press, Internet, YouTube channels, social networks. The same number of respondents got acquainted with innovations during lectures at college, slightly more than a tenth - during practice, the smallest part (3.1 percent) of students got to know innovations when they started working during their studies. A tenth of the respondents (12.8 percent) did not have the opportunity to familiarize themselves with innovations at all (see Figure 4). This shows that students usually get to know innovations not by directly observing or participating in innovation creation activities, but virtually, or knowledge about innovations is transmitted by other people, in the case of the study, teachers.

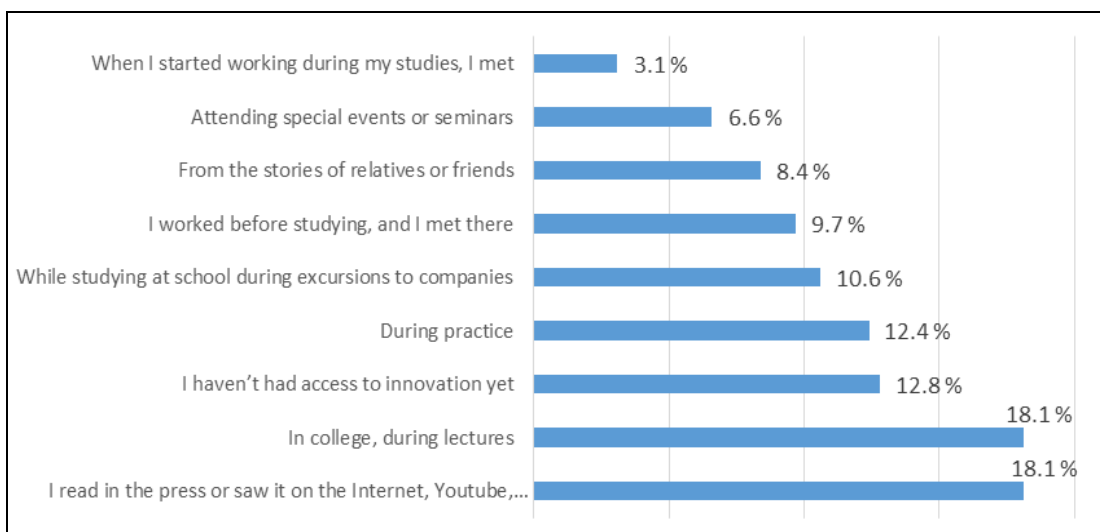


Fig. 4 Circumstances of students' acquaintance with innovations

Based on the results of the research, it can be stated that the stages of idea generation and concept development were indicated as the best known by 16 percent of the respondents. A similar share went to innovation design - 14.3 percent. 12 percent of the respondents were familiar with the production, testing and improvement of a test sample (prototype). The same part of the respondents was familiar with the presentation of the innovation as a fully manufactured product to consumers. The production start-up stage is familiar to a tenth of the respondents, and the commercialization stage - only 4 percent respondents. It is important to note that the largest share - as much as 18.9 percent of all respondents indicated that they are not yet familiar with the stages of innovation development (see Figure 5). The last choice correlates with the answer to the question about the known type of innovation, so it can be said that if the respondents are not familiar with the stages of innovation development, in this case they do not know what innovation is and do not recognize different types of innovation. It is also important to note that respondents are most familiar with the first two stages of innovation development, which are usually characterized by non-standard, creative solutions. The least known is commercialization, which is indicated in other studies (Leichteris E., 2011; Giriūnienė, Benetytė, 2012) as the most risky and complicated process of transferring the economic benefits of an innovation.

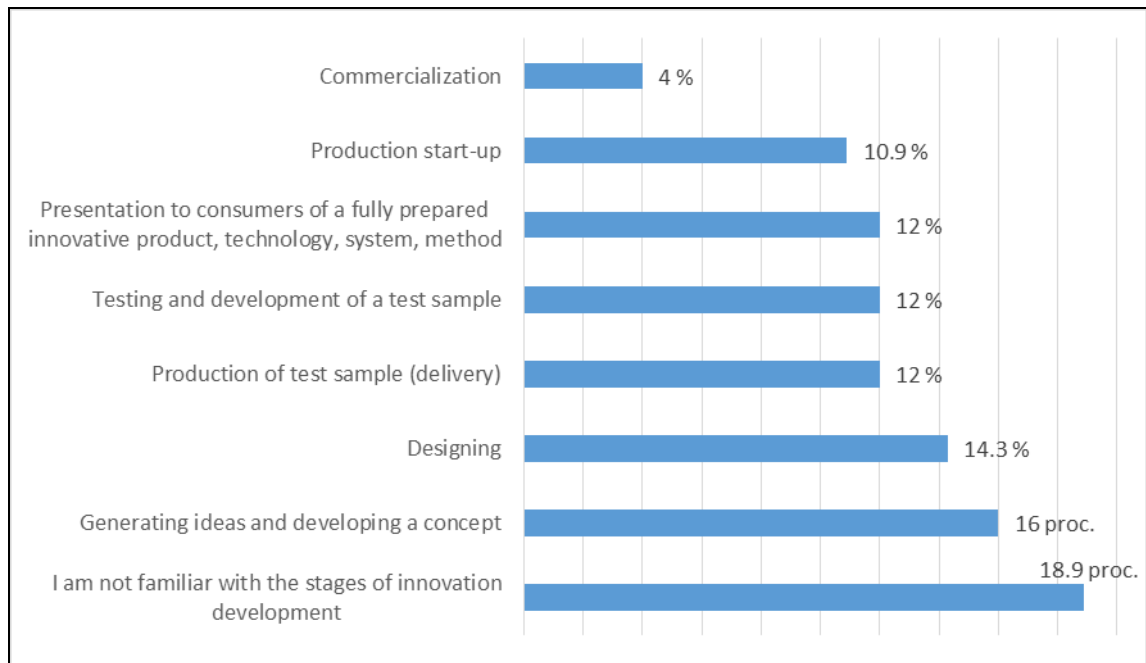


Fig. 5 Acquaintance of students with innovations according to their development stages

Innovation thrives when people are motivated to work and the organization supports their creativity. However, it is necessary to constantly assess the possible obstacles that can prevent the emergence and development of innovations. Despite the fact that a relatively large part of the respondents have not yet come across innovations, the rest are already familiar with the most diverse innovations. Products, technologies, systems, methods, etc. innovations with which the respondents are familiar are presented in Table 1:

Table 1

Innovations known to students

Product innovation	Mobile phone, robot-pump, drones, etc., "Agrifac", "Agronutrition", "Knauf", ceramic acoustic and EKO blocks, spray vitamins "Smart way", MD panels, lasers.
Technological innovation	LECTRA cutting machine, 4.0 industry, abandoning gluing of frames with sintepon and foam rubber and switching to sticking sintepon to the frame, innovative and integrated business management system Lean (2), Kanban, Poka Yoke, meat processing technologies, Nvidia DLSS (Deep Learning Super Sampling), improvement of car technologies, improvement of tractor technologies, improvement of computer technology, Autocad, Triumph Trupunch, Inventor, Photoshop, Solidworks, Revit100, Adobe Indesign, Corel draw, production of Mdp panels, fireproofing of metal structures, new Graco painting equipment. Belzona products for pipeline repair, automatic production lines, new generation glass carving machines HEGLA galactic, laminated glass cutting machines HEGLA prolam 37 and 46, glass tempering glaston VC500, glass processing (bending, grinding, polishing) trout machines, installation and commissioning of automated packaging lines, equipment maintenance.
Social innovation	Innovations in museums (Palace of Rulers, Basketball Museum, etc.), libraries (e.g. Povilas Višinskis Public Library of Šiauliai County) employment app, digitized cemeteries, opportunity passport, integrated criminal process information system, marketing innovations.

The examples of the best remembered innovations provided by the respondents show that product and social innovations are less familiar compared to technological innovations. The most examples of technological innovations were presented by students of engineering study programs, who had more opportunities to get acquainted with the latest technological equipment, programs and process management systems.

Conclusions

According to the study, students are most familiar with technological innovations. Product and social technology innovations are familiar to almost the same number of students - about a fifth. A similar number of students did not have the opportunity to get acquainted with any innovations and innovations at all.

The circumstances in which students get to know innovations are very diverse, but they usually learn about them in higher education institution during lectures or find them on the Internet, social networks, YouTube channels or read about them in the press. A little less gets to know them during practice. A similar proportion of students did not yet have the opportunity to familiarize themselves with innovations. Before studying in higher education institution, only a tenth of the students got acquainted with innovations while studying or working.

The analysis shows that the students know the generation of ideas and concept development the best, and the commercialization of an innovative product the least. Other stages, such as: production start-up, design, presentation of the manufactured and fully developed innovative product to consumers, etc. are less familiar to students. According to the presented examples of innovations, it was established that technological innovations, various equipment, new programs, innovative management systems are best remembered. This shows that students pay more attention not to the final innovative products themselves, but to the innovative product development processes. This aspect of the study is important to encourage higher education students to engage in innovation studies. Also, the higher education institution should look for teaching methods that would help students better understand the commercialization of innovations and encourage their greater involvement in the development of innovations both during studies and in further professional activities.

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EFFECT OF BALANCE TRAINING EXERCISES ON KICKBOXING ATHLETE'S BALANCE, MUSCLE STRENGTH AND REACTION TIME IN CHRONIC ANKLE JOINT INSTABILITY: A CASE STUDY

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Annotation

The purpose of this study was to evaluate the effect of 12 weeks of balance training on balance, muscle strength and reaction time of a kickboxing athlete with chronic ankle instability. Ankle instability causes long-term pain, disability, negatively affects quality of life and reduces physical activity and time to returning to the sports. The novelty of this study is that there is a lack of research on the effect of balance training exercises on balance, reaction time and strength of the muscles surrounding the ankle joint in kickboxers with chronic ankle instability.

Key words: *Error based balance training, ankle sprain, chronic ankle instability, kickboxing.*

Introduction

Presentation of the problem:

In kickboxing 26,1 % of all injuries are to the lower limbs, frequently to knee and ankle ligaments [5;11]. The first ankle ligament sprain can adversely affect the function of the ankle joint, leading to chronic ankle instability and post-traumatic osteoarthritis. These injuries tend to be most symptomatic in high-demand athletes in whom ankle instability causes significant functional disability [7;2]. Evidence shows that at least 4 weeks of balance training can improve physical and functional parameters such as balance, reaction time and muscle strength in healthy individuals with chronic ankle instability [3;6]. There is a lack of research on the effect of balance training on balance, reaction time and strength of the muscles surrounding the ankle joint in kickboxers with chronic ankle instability.

The aim of the research:

To evaluate the effect of a balance training program on balance, muscle strength and foot reaction time of a kickboxing athlete with chronic ankle joint instability.

Research objectives:

To determine the effect of a balance training program on kickboxing athlete's, suffering from chronic ankle joint instability, balance, muscle strength of muscles surrounding the ankle joint and reaction time. Also to compare changes of balance, muscle strength of muscles surrounding the ankle joint and foot reaction time for a kickboxing athlete suffering from chronic ankle joint instability before and after the physiotherapy program.

Methodology:

Organization of the study: study was carried out in Faculty of Health Care, Šiauliai State University of Applied Sciences. Study started on 2021-12-17 and was finished on 2022-03-14.

A case study was used to evaluate and compare the effects of a physiotherapy program on balance, foot reaction time and strength of the muscles surrounding the ankle joint of a kickboxer with chronic ankle instability. The purpose of this study and its benefits for the participant were explained to the respondent. The research was conducted in accordance with the ethical principles of research ethics and the principles adopted in the Declaration of Helsinki concerning medical research on human subjects. *Subjects:* the subject was chosen in accordance of the selection criteria (type of sports - kickboxing, as 26% of injuries in kickboxing are lower limb injuries; male gender, as statically male kickboxers are more likely to sustain injuries than female kickboxers; subject has sustained multiple ankle sprains over the years and experiences symptoms of chronic instability). The subject – 1 male kickboxer, 21 years of age who suffered a sprain of the tibiofemoral ligaments (clinical diagnosis code S93.4), several

sprains of the ankle ligaments (clinical diagnosis codes S93.40 and S93.6), and a fracture of talus (clinical diagnosis code S92.1) since 2020. The subject underwent a 12-week physiotherapy program consisting of balance training exercises created by Cuğ et al. (2016), which was based on progressive difficulty based on errors. The main difference with Cuğ et al. (2016) study was that in order to better analyse effect of these exercise, study time was increased to 12 weeks and consisted of 3 assessments during the study. Balance training program consisted of 4 exercises on the BOSU ball. Each exercise had 12 step progression plan, where difficulty was increased every week. Before the balance training exercises a 5-minute warm-up was done consisting of range of motion exercises on the ankle joint.

Research methods: The assessment of the balance, muscle strength of muscles surrounding the ankle joint and foot reaction time were conducted three times: before the study (assessment 1), after 6 weeks (assessment 2) and after 12 weeks (assessment 3). The result analysis was carried out using Microsoft Excel program where percentage changes and graphs were made. For the assesment of dynamic balance the star excursion test was used. The test was done three times in each direction: anterior, posteromedial and posterolateral. Both legs were examined. The best result out of three trials was used for analysis of the results. For the assesment of static balance the flamingo test was used. The test was done on each leg and the test was considered as failed if the subject fell off the beam 15 times in 30 seconds. For the assesment of static and dynamic balance HUBER 360 multi-directional motorized platform was used. The subject had to follow the instructions on the screen of the HUBER 360 platform and perform the test without any instructions from the researcher. The testing was observed by the researcher. The following tests were done for the assesment: stability length, stability area, stability velocity, length of balance, area of balance, walking test and limits of stability. For the assesment of muscle strength of the muscles surrounding the ankle joint a hand-held dynamometer was used. The test was done on each leg three times for each muscle group and the average score was calculated. For the assesment of foot reaction time the reactiometer RA-1 was used. The test was done on each leg using pedals. Foot reaction time was tested on each leg seperately to auditory and visual stimulus and on both legs together to visual stimulus.

Analysis of results

Results of the modified star excursion test

While comparing the results of assessment 1 and assessment 2 of the subject's left leg push-off distance we found an improvement of 6 cm (9%) in the anterior direction, 9.5 cm (8%) in the posteromedial direction and 7.5 cm (6%) in the posterolateral direction. While comparing the results of assessment 2 and assessment 3 we found an improvement of 5 cm (7%) in the anterior direction, 3,5 cm (3%) in posteromedial direction, and in the posterolateral direction by 4 cm (3%) (Figure 1). While comparing the results of assessment 1 and assessment 3 we found an improvement of 11 cm (16%) in the anterior direction, 13 cm (11%) in posteromedial direction, and in the posterolateral direction by 11 cm (10%) (Fig. 1).

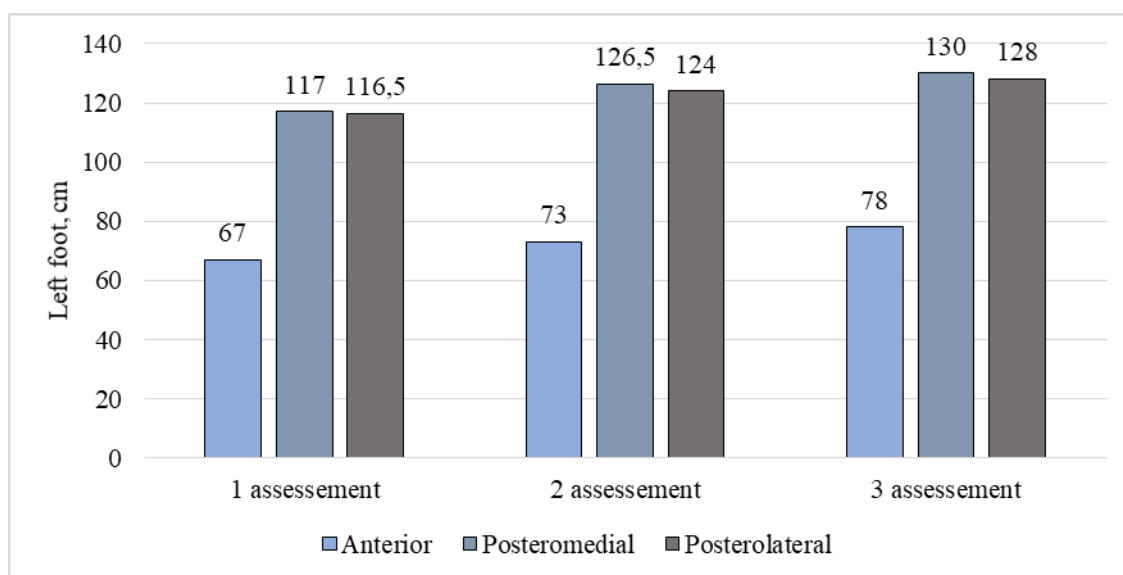


Fig. 1. Modified star test results before, after 6 and 12 weeks of physiotherapy.

While comparing the results of assessment 1 and assessment 2 of the subject's left leg push-off distance we found an improvement of 5,5 cm (8%) in the anterior direction, 10 cm (9%) in the posteromedial direction and 8 cm (7%) in the posterolateral direction. While comparing

the results of assessment 2 and assessment 3 we found an improvement of 3 cm (4%) in the anterior direction, 6,5 cm (5%) in posteromedial direction, and in the posterolateral direction by 4 cm (3%). While comparing the results of assessment 1 and assessment 3 we found an improvement of 8,5 cm (13%) in the anterior direction, 16,5 cm (15%) in posteromedial direction, and in the posterolateral direction by 12 cm (11%) (Fig. 2).

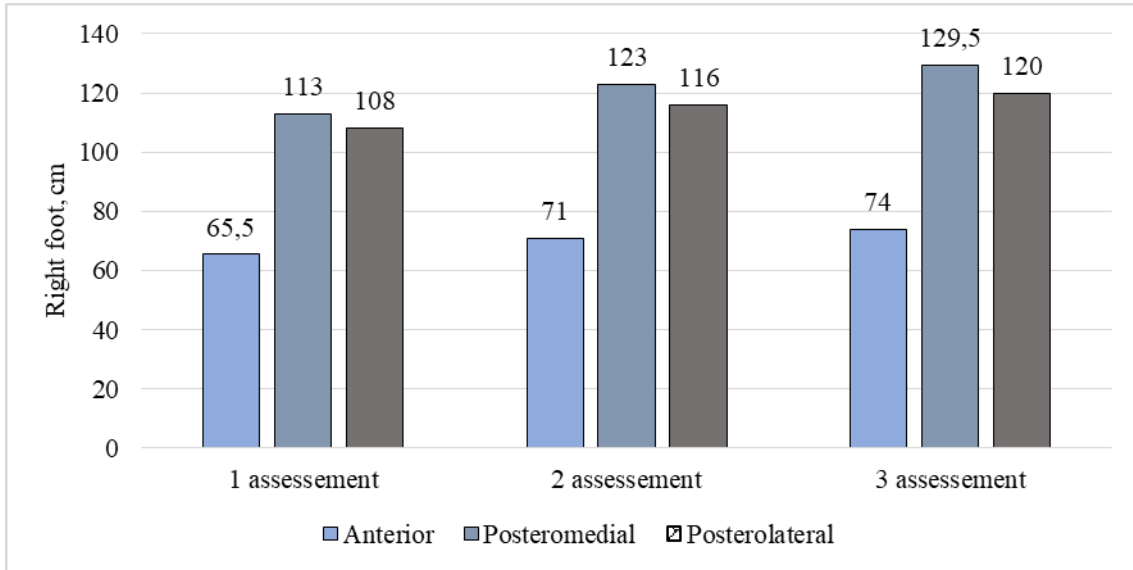


Fig. 2. Modified star test results before, after 6 and 12 weeks of physiotherapy.

Results of the flamingo test

While comparing the results of assessment 1 and assessment 2 of the subject's left leg number of errors we found an improvement of 3 points (25%). While comparing the results of assessment 2 and assessment 3 of the subject's left leg number of errors we found an improvement of 2 points (22%). While comparing the results of assessment 1 and assessment 3 of the subject's left leg number of errors we found an improvement of 5 points (42%) (Fig. 3).

While comparing the results of assessment 1 and assessment 2 of the subject's right leg number of errors we found an improvement of 2 points (14%). While comparing the results of assessment 2 and assessment 3 of the subject's right leg number of errors we found an improvement of 2 points (17%). While comparing the results of assessment 1 and assessment 3 of the subject's right leg number of errors we found an improvement of 4 points (29%) (Fig. 3).

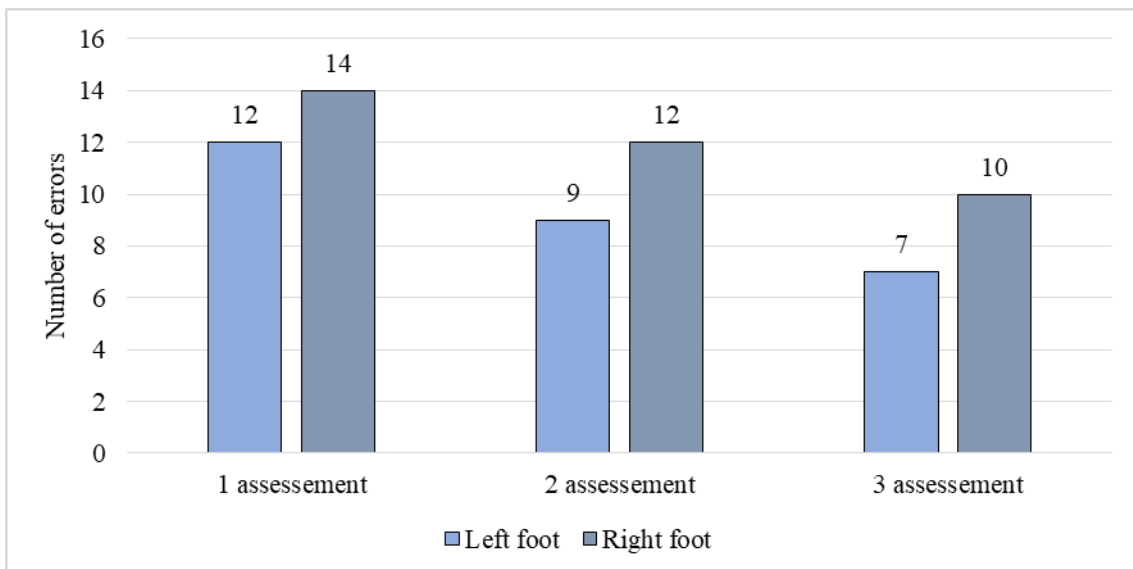


Fig. 3. Left and right foot flamingo test results before, after 6 and 12 weeks of physiotherapy

Results of dynamometry

While comparing the results of assessment 1 and assessment 2 of the subject's left lower leg muscle strength we found an improvement of 1 kg (6%) in dorsiflexion, 2 kg (14%) in plantarflexion, 1 kg (33%) in inversion and 2 kg (67%) in eversion. While comparing the results of assessment 2 and assessment 3 of the subject's left lower leg muscle strength we found an improvement of 3 kg (16%) in dorsiflexion, 1 kg (6%) in plantarflexion, 2 kg (15%) in inversion and 2 kg (14%) in eversion. While comparing the results of assessment 2 and assessment 3 of the subject's left lower leg muscle strength, we found an improvement of 5 kg (22%) in dorsiflexion, 3 kg (21%) in plantarflexion, 3 kg (20%) in inversion and 4 kg (33%) in eversion (Fig. 4).

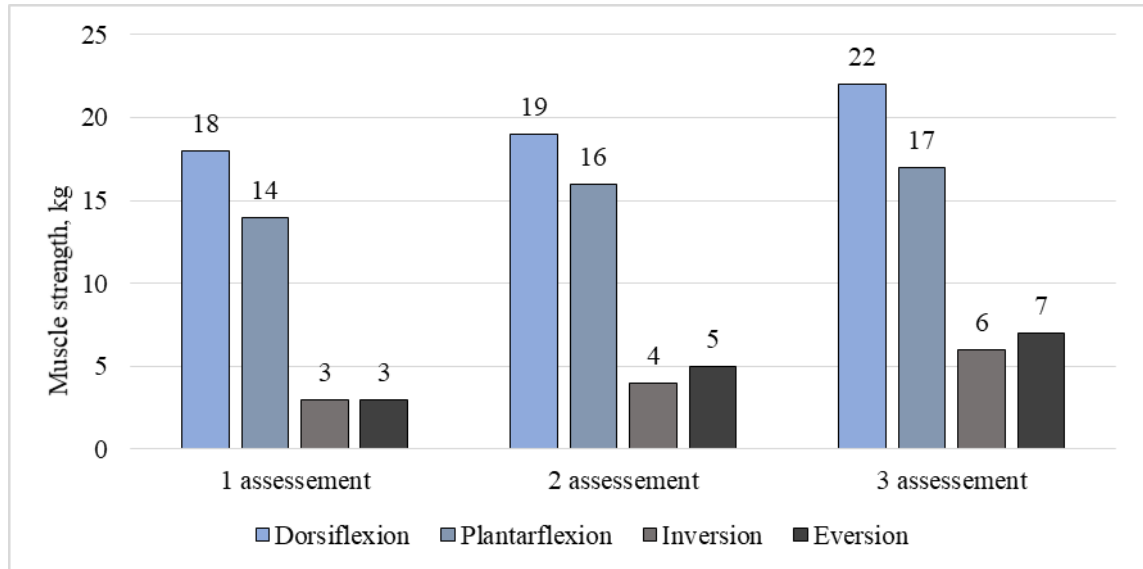


Fig. 4. Left calf muscle strength results before, after 6 and 12 weeks of physiotherapy

While comparing the results of assessment 1 and assessment 2 of the subject's right lower leg muscle strength we found an improvement of 2 kg (13%) in dorsiflexion, 3 kg (25%) in plantarflexion, 1 kg (25%) in eversion and no change in inversion. While comparing the results of assessment 2 and assessment 3 of the subject's right lower leg muscle strength we found an improvement of 3 kg (17%) in dorsiflexion, 2 kg (13%) in plantarflexion, 2 kg (67%) in inversion and 2 kg (67%) in eversion. While comparing the results of assessment 1 and assessment 3 of the subject's right lower leg muscle strength we found an improvement of 5 kg (31%) in dorsiflexion, 5 kg (42%) in plantarflexion, 2 kg (67%) in inversion and 3 kg (25%) in eversion (Fig. 5).

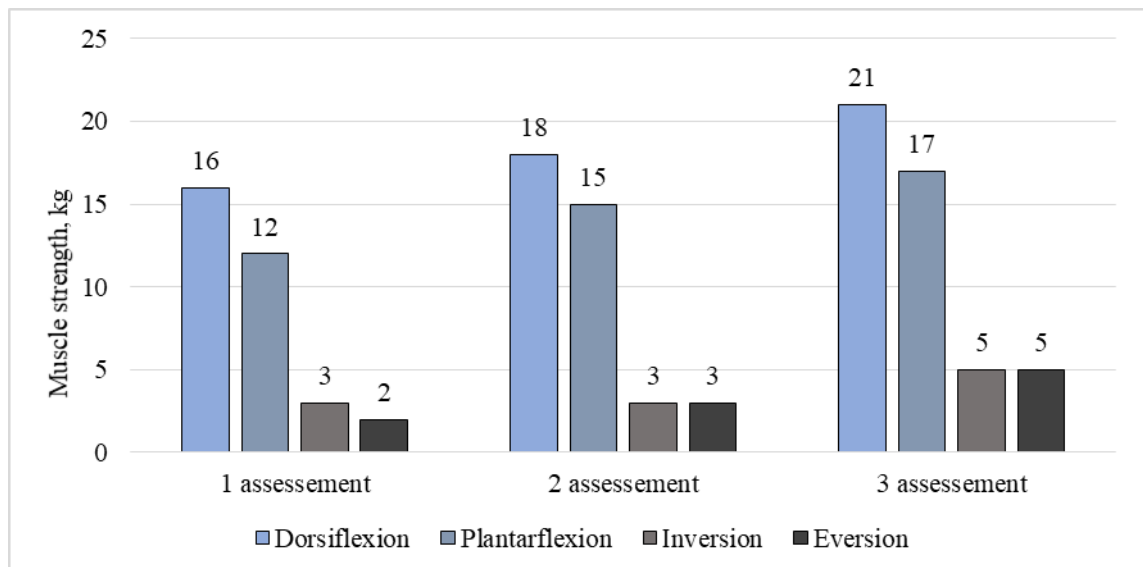


Fig. 5. Right calf muscle strength results before, after 6 and 12 weeks of physiotherapy

Results of the reactiometer RA-1 results

While comparing the results of assessment 1 and assessment 2 of the subject's reaction time to light stimulus we found an improvement of 5.12 ms in left leg, 23.5 ms in right leg, 70.9 ms in both left and right legs. While comparing the results of assessment 2 and assessment 3 of the subject's reaction time to light stimulus we found an improvement of 48.88 ms in left leg, 8.3 ms in right leg, 36.83 ms in both left and right legs. While comparing the results of assessment 1 and assessment 3 of the subject's reaction time to light stimulus we found an improvement of 54 ms in left leg, 31.8 ms in right leg, 107.73 ms in both left and right legs (Fig. 6).

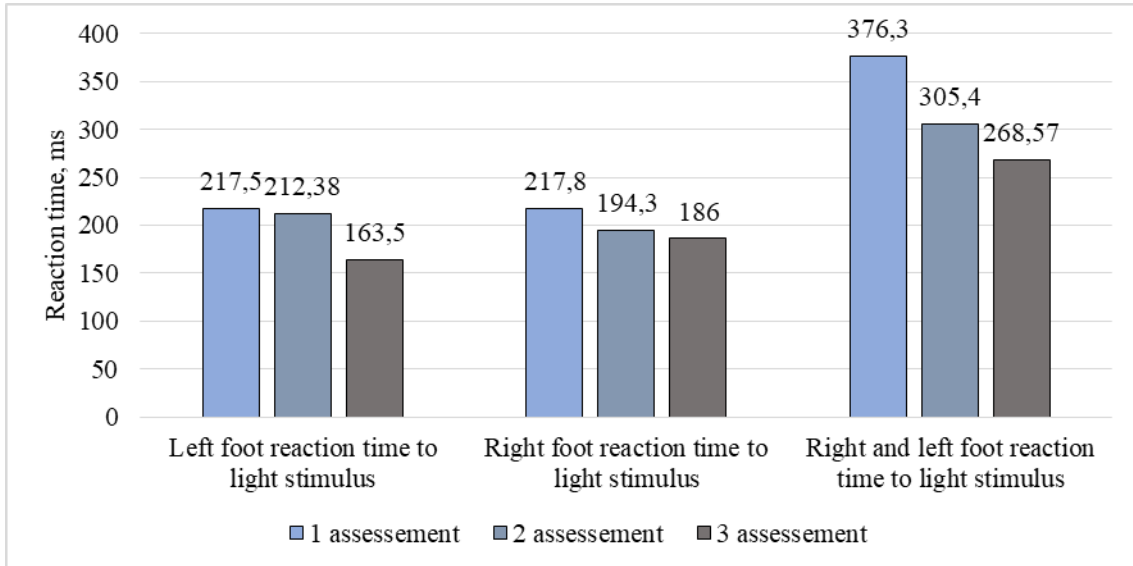


Fig. 6. Right and left foot reaction time to light stimulus results before, after 6 and 12 weeks of physiotherapy

While comparing the results of assessment 1 and assessment 2 of the subject's reaction time to light stimulus we found an improvement of 23.7 ms of left leg, 16.5 ms in right leg. While comparing the results of assessment 2 and assessment 3 of the subject's reaction time to light stimulus we found an improvement of 30.47 ms in left leg, 41.17 ms in right leg. While comparing the results of assessment 1 and assessment 3 of the subject's reaction time to light stimulus we found an improvement of 54.17 ms in left leg, 57.67 ms in right leg (Fig. 7).

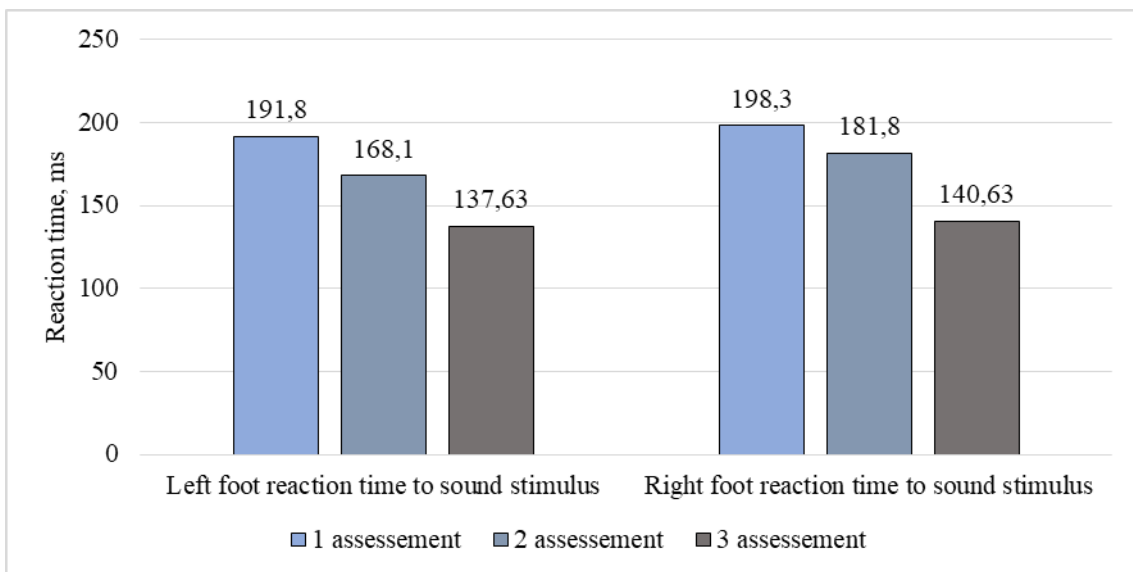


Fig. 7. Right and left foot reaction time to sound stimulus before, after 6 and 12 weeks of physiotherapy

The results of HUBER 360 multi-directional motorized platform

Stability assessment. The stability of the subject was assessed using the following parameters: stability length, stability area and stability velocity. While comparing results of

assessment 1 and assessment 2 in the subject stability length we found an improvement of 23.27 mm (4%) with eyes opened and 69.61 mm (8%) with eyes closed. While comparing results of assessment 2 and assessment 3 in the subject stability length we found an improvement of 69,83 mm (13%) with eyes opened and 85,78 mm (11%) with eyes closed. While comparing results of assessment 1 and assessment 3 in the subject stability length we found an improvement of 93,1 mm (17%) with eyes opened and 155,39 mm (18%) with eyes closed (Fig. 8).

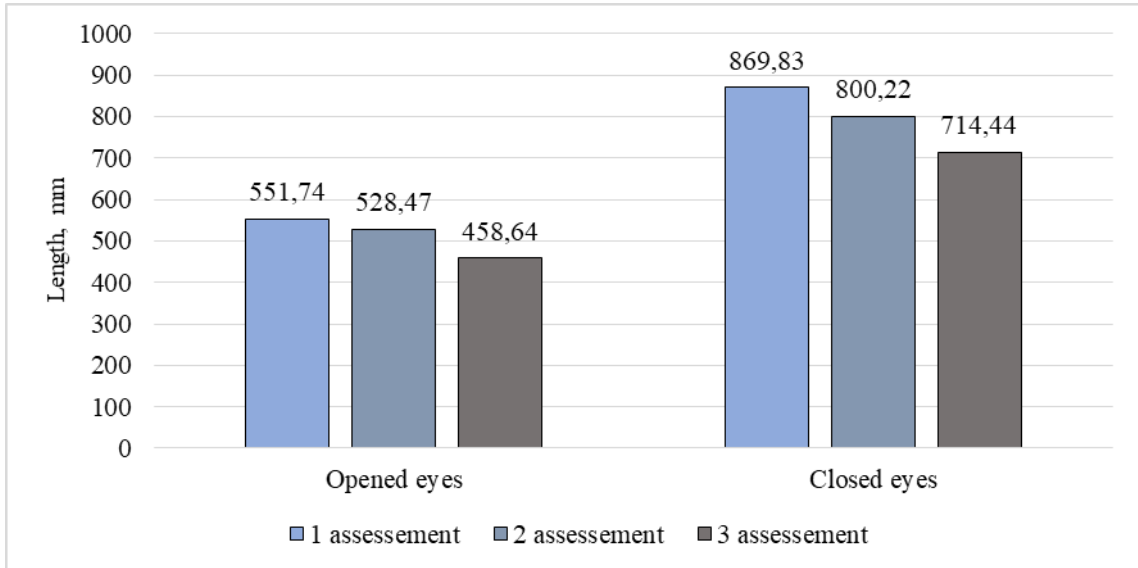


Fig. 8. Stability length with opened and closed eyes results before, after 6 and 12 weeks of physiotherapy

While comparing results of assessment 1 and assessment 2 in the subject stability area we found a regression of 103,08 mm² (68%) with eyes opened and 31,25 mm² (8%) with eyes closed. While comparing results of assessment 2 and assessment 3 in the subject stability area we found an improvement of 170,88 mm² (67%) with eyes opened and 5,74 mm² (1%) with eyes closed. While comparing results of assessment 1 and assessment 3 in the subject stability area we found an improvement of 67,8 mm² (45%) with eyes opened and a regression of 25,51 mm² (7%) with eyes closed (Fig. 9).

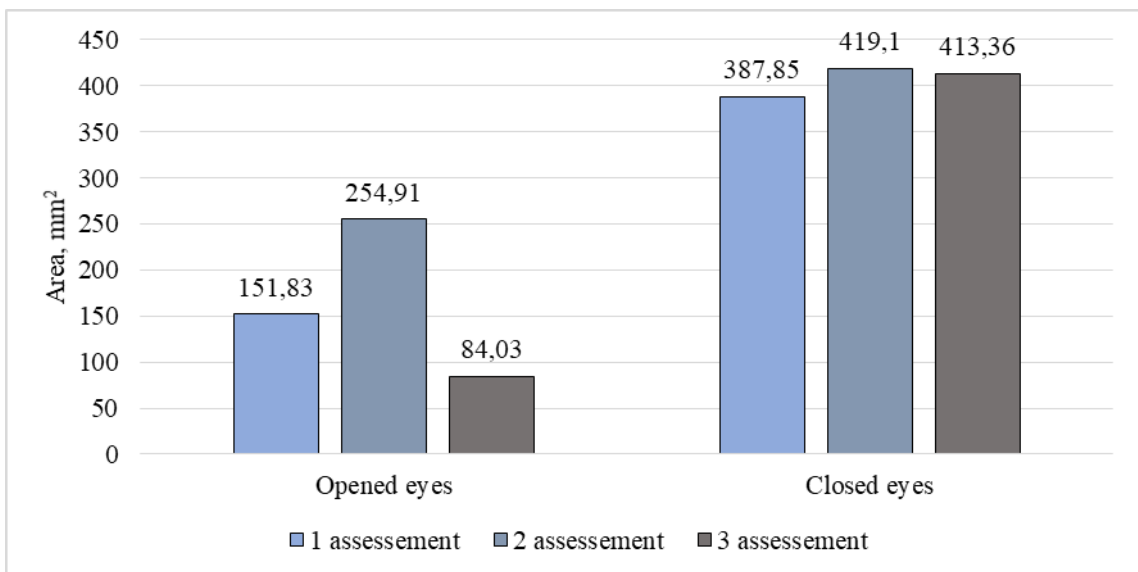


Fig. 9. Stability area with opened and closed eyes results before, after 6 and 12 weeks of physiotherapy

While comparing results of assessment 1 and assessment 2 in the subject stability velocity we found an improvement of 0.53 mm/s (5%) with eyes open and 1.4 mm/s (8%) with eyes closed. While comparing results of assessment 2 and assessment 3 in the subject stability

velocity we found an improvement of 1.33 mm/s (13%) with eyes open and 1.71 mm/s (11%) with eyes closed. While comparing results of assessment 1 and assessment 3 in the subject stability velocity we found an improvement of 1.86 mm/s (17%) in eyes open and 3.11 mm/s (18%) in eyes closed (Fig. 10).

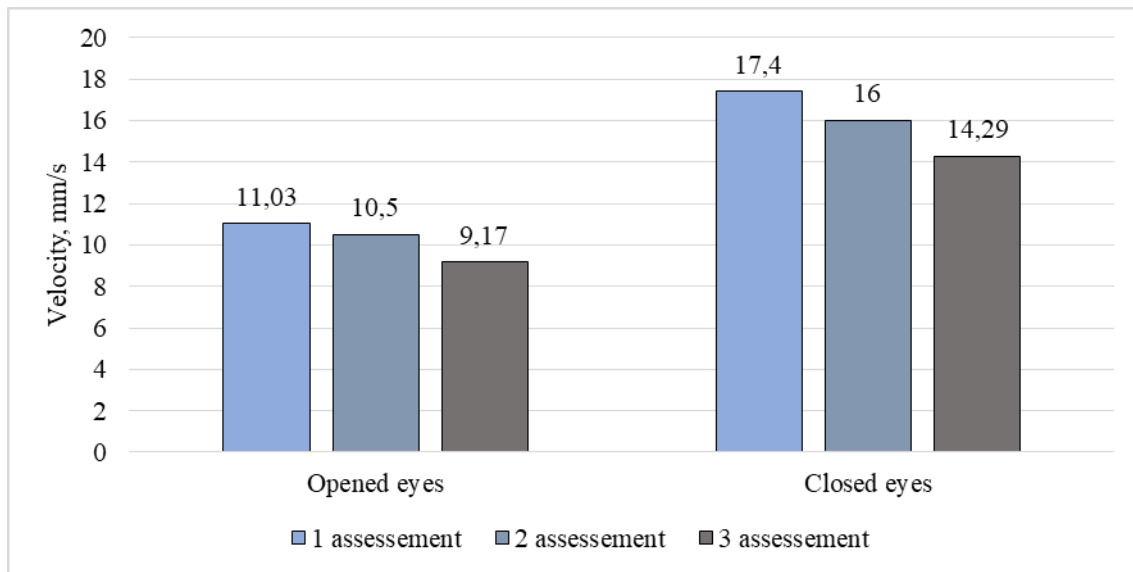


Fig. 10. Stability velocity with opened and closed eyes results before, after 6 and 12 weeks of physiotherapy

Balance assessment. The indicators used to assess the subject's balance were: length of balance and area of balance. While comparing results of assessment 1 and assessment 2 in the length of balance we found an improvement of 13.62 mm (0.8%) while standing on the left leg and a regression by 19.6 mm (0.9%) while standing on the right leg. While comparing results of assessment 2 and assessment 3 in the length of balance we found an improvement of 376.88 mm (23%) while standing on the left leg and 333.23 mm (15%) while standing on the right leg. While comparing results of assessment 1 and assessment 3 in the length of balance we found an improvement of 390.5 mm (23%) on the left leg and 313.63 mm (15%) on the right leg (Fig. 11).

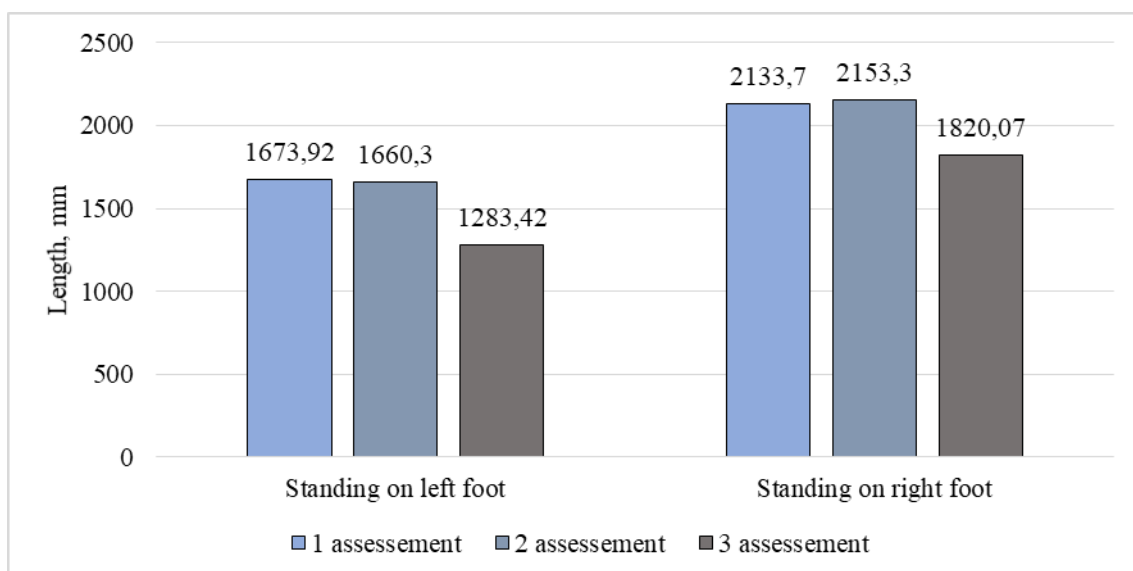


Fig. 11. Balance length standing on left and standing on right foot results before, after 6 and 12 weeks of physiotherapy

While comparing results of assessment 1 and assessment 2 in the area of balance we found a regression of 291.38 mm² (32%) on the left leg and 199.59 mm² (15%) on the right leg. While comparing results of assessment 2 and assessment 3 in the area of balance we found a regression of 780.37 mm² (64%) on the left leg and an improvement of 163.88 mm² (11%) on

the right leg. While comparing results of assessment 1 and assessment 3 in the area of balance we found a regression of 1073.75 mm² (215%) on the left leg showed and 35.71 mm² (3%) on the right leg (Fig. 12).

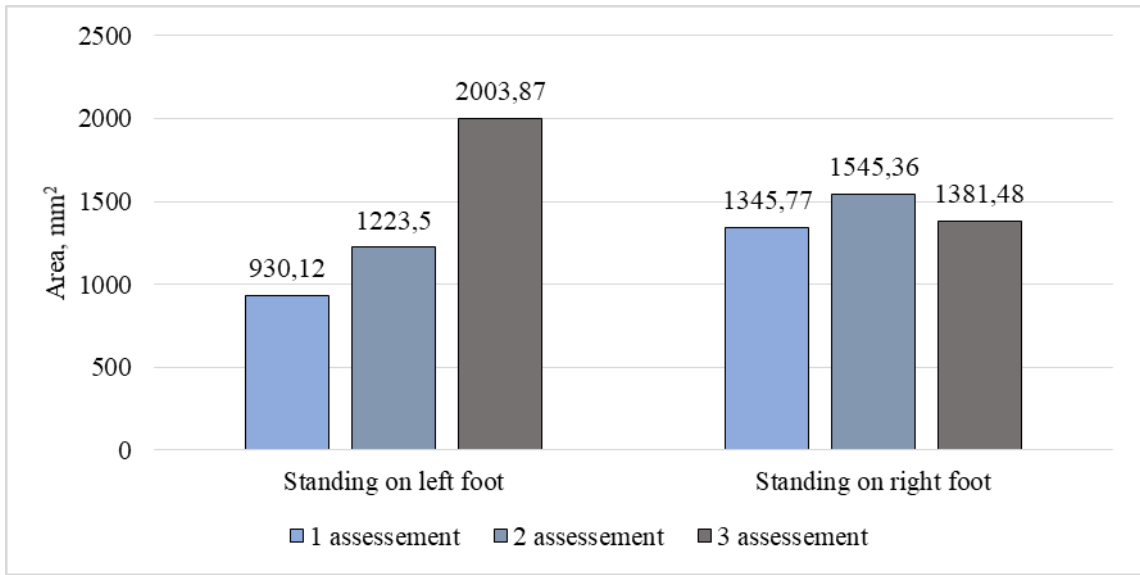


Fig. 12. Balance area standing on left foot and standing on right foot results before, after 6 and 12 weeks of physiotherapy

Walking test. While comparing results of assessment 1 and assessment 2 on the subject's walking speed over 50 seconds we found an improvement of 7 steps (9%). While comparing results of assessment 2 and assessment 3 on the subject's walking speed over 50 seconds we found an improvement of 15 steps (19%). While comparing results of assessment 1 and assessment 3 on the subject's walking speed over 50 seconds we found an improvement of 22 steps (30%) (Fig. 13).

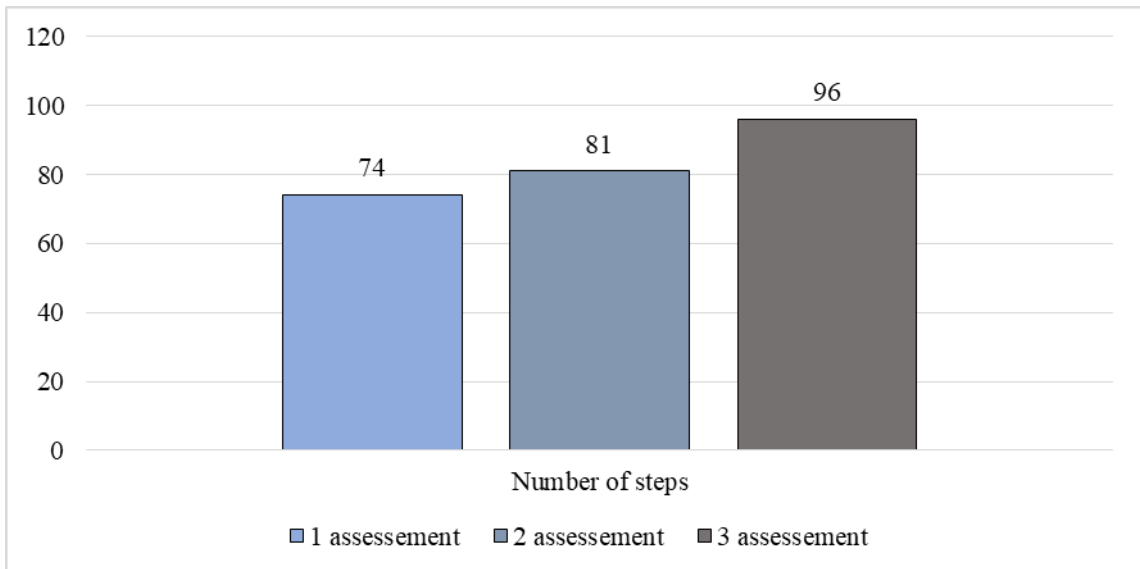


Fig. 13. Number of steps results before, after 6 and 12 weeks of physiotherapy

Limits to stability. While comparing results of assessment 1 and assessment 2 on the subject's maximum amplitude of stability limits in 8 directions we found an improvement of 2102.13 mm (2%). While comparing results of assessment 2 and assessment 3 on the subject's maximum amplitude of stability limits in 8 directions we found an improvement 8985.66 mm (9%). While comparing results of assessment 1 and assessment 3 on the subject's maximum amplitude of stability limits in 8 directions we found an improvement 11087.79 mm (11%) (Fig. 14).

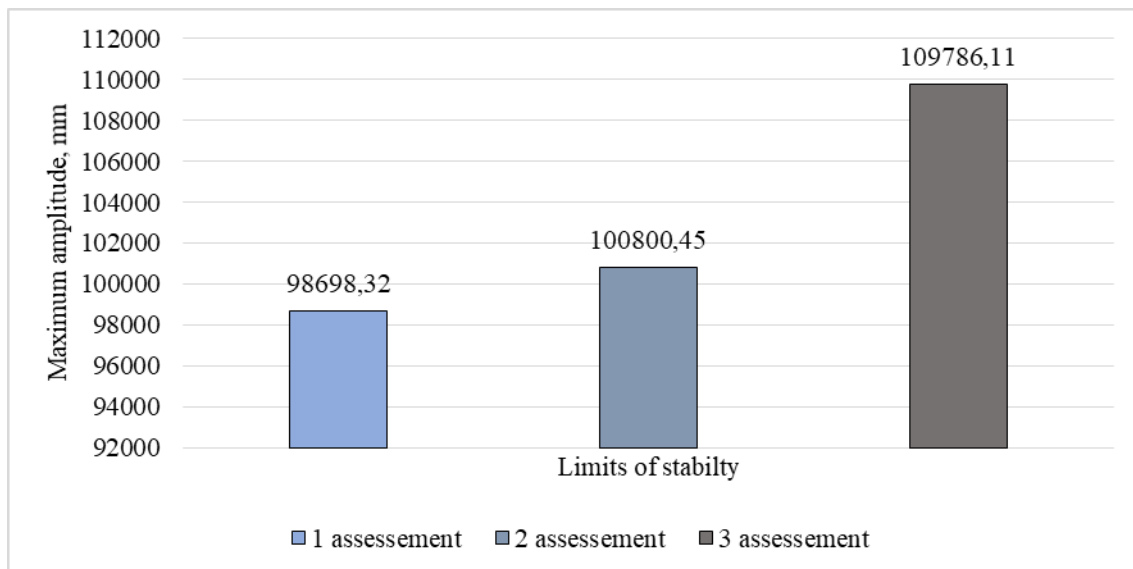


Fig. 14. Limits of stability results before, after 6 and 12 weeks of physiotherapy

Discussion

The aim of this study was to evaluate the effect of a balance training program on balance, muscle strength and foot reaction time of a kickboxing athlete with chronic ankle joint instability. After the study we found that a 12-week balance training program improved the subject's dynamic and static balance, lower limb muscle strength, foot reaction time, coordination of an ankle.

Increased muscle strength also has an effect on static balance. When muscles, surrounding the ankle joint become stronger and more coordinated, they can stabilize ankle joint better, thus static balance while standing on one leg also improves. When there is better muscle response, ankle posture changes also, there are less unnecessary movements, joint stays stable inspite of internal or external stimulus.

Reaction time improves also when muscle strength and balance increase. While performing exercises on unstable surfaces, afferent and efferent impulses between CNS and lower limb increases, thus reaction time shortens. That allows to maintain optimal ankle joint stability and coordination. When muscles surrounding ankle joint become stronger, they not only stabilize the joint better, but also can contract faster and effectively adjust position necessary for movements.

According to the authors of the balance training program that was used in our study, a 4-week balance training program consisting of exercises with progressive difficulty on a BOSU ball improved strength of the muscles surrounding the ankle joint [3]. In our study we found that the balance training program improved strength of muscles involved in plantarflexion, dorsiflexion and eversion. In comparison of the strength of the muscles surrounding the ankle joint from Cuğ and co-authors' (2016) study showed that 4 weeks of balance training program improved strength of the muscles involved in plantarflexion, dorsiflexion, eversion and inversion ($p < 0.05$). Meanwhile, Deussen and co-authors (2018) conducted a study on the effect of exercises on a wobble balance board and soft surfaces on athletes who sustained ankle sprains [4]. The study results showed an increase in the strength of the athletes' muscles involved in eversion and inversion and found that a 6-week program showed a more significant increase in muscle strength than a 10-week program. The authors suggest that sensorimotor training on unstable surfaces may have contributed to the prolonged neuromuscular adaptation leading to the increase in the strength of the muscles surrounding the ankle joint.

A systematic review and meta-analysis conducted by Plangtaison and co-authors (2021) showed that the reflexive response to external stimuli is worse in individuals with chronic ankle instability. Because of lower reflexive response the adaptivity to sudden and changing movements is weakened and it is more difficult to avoid ankle sprains. In a selected study investigating the effects of balance, neuromuscular and proprioception training on the response time of the core muscles showed that neuromuscular and proprioceptive training improves hamstring muscle reaction time and thus reduces the risk of injury [8]. Balance training improves the athlete's reaction time and lower limb stability control while standing on the ground. It also enhances the signals sent by the proprioceptors, which results in a feedback loop which trains the athlete's balance and improves body positioning awareness in changing conditions [9]. In our study the subject's lower limb reaction time of the subject's left and right

leg was reduced. For kickboxing athletes, muscle strength and reaction time are important components to achieve excellence in competition. Kickboxing mainly consists of dynamic and short actions performed in a very short period of time, therefore lower limb muscle strength and reaction time are important during training and competition [12]. In comparison with the authors of the balance program our study showed an improvement of dynamic balance. In the original study a moderate improvement was found in dynamic balance in the anterior direction, but even more significant increase was found in posteromedial and posterolateral directions. Meanwhile, in a study done by Schaefer and co-authors (2012), an identical balance training program and dynamic balance assessment was used and it was found that individuals with chronic ankle instability showed a greater improvement of dynamic balance in anterior direction [10]. A study conducted by Benis and co-authors (2016) investigated the changes of dynamic balance in professional basketball players following a neuromuscular exercise program and found that neuromuscular and plyometric exercises improved dynamic balance in posteromedial and posterolateral directions as well as the composite outcomes in both limbs [1].

In our study we found an improvement of the subject's static balance as the number of errors made with the left leg decreased by 5 errors and the number of errors made with the right leg decreased by 4 errors. Tanir and co-authors (2018) conducted an 8-week study investigating static and dynamic balance in soccer players aged 10-12 years. The program used in the study consisted of exercises on a BOSU ball, gymnastics ball and balance board, plyometric and spinal stabilization exercises [13]. The study showed an improvement in static balance.

The results obtained in this study may have been limited by several aspects. Firstly, the subject was involved in 8 hours of standing physical work followed by an assessment. The fatigue caused by the physical work could have negatively affected the results. Secondly, the subject contracted COVID-19 before assessment 2 and the subject still continued the exercise program. Also, after his recovery the subject immediately started intensive training for kickboxing competitions. At that time, the intensity and number of training sessions was increased to 5 times per week and 2 times per day. During the competition, the subject sustained several right leg ankle ligament sprains. Also, the outcome of the competition was affected by breathing difficulties caused by COVID-19. These causes may have affected the subject's results of 2nd assessment.

In over all, despite several study limitations, we got a significant increase in ankle joint functions and physical parameters focusing only on ankle joint. Thus, future researchers should consider including evaluation of knee and hip joint functions when performing these exercises, analyze how changes in these regions change results of ankle function and vice versa. Also we would recommend to include assessment and exercises of core region as it has big influence to overall balance.

Conclusions

Chronic ankle joint instability is a condition that affects the ankle joint, that causes loss of muscle strength, pain and disturbance of proprioception and balance. An effective rehabilitation program consisting of muscle strength and balance training exercises on unstable surfaces is important in the case of chronic ankle joint instability. A 12-week balance training program on the BOSU ball improved the subject's dynamic and static balance, increased the strength of the muscles involved in flexion, extension, inversion and eversion of the foot, increased the reaction time of the lower limbs and reduced ankle joint pain. While comparing the changes before and after balance training program we found that balance, muscle strength of the muscles surrounding the ankle joint and lower extremity reaction time improved after the physiotherapy program.

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ASSESSMENT OF THE RELIABILITY OF INFORMATION IN THE COMPANY'S FINANCIAL STATEMENTS BASED ON MODELS J. MONTHIER, M. D. BENISHA AND M. L. ROXAS

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Annotation

The article assesses the reliability of the information in the financial statements of PJSC "Morshinsky Mineral Water Plant "Oscar" for 2016-2020 based on the model of J. Montier (C-Score), M. D. Benish (M-Score (8 variable), M L. Roxas (M-Score (5 variable)). To assess the reliability of information in the financial statements of domestic economic entities of various forms and types of activity, it is proposed to use the model of M. D. Benish (8 variable) and M. L. Roxas (5 variable) based on the study of the essence, the order of application and justification of their advantages (relative ease of application, forecasting potential, breadth of use). The algorithm for calculating the indicators of the model of J. Montier (C-Score), M. D. Benish (M-Score (8 variable), M. L. Roxas (M-Score (5 variable) in accordance with the forms of financial reporting approved in Ukraine, which will allow determining the level of reliability of the reported information.

Key words: *credibility, manipulation, model of J. Montier, model of M. D. Benish, model of M. L. Roxas, falsification, financial reporting of the enterprise.*

Introduction

Formulation of the problem. In modern business market conditions, constant changes in tax and accounting legislation lead to the distortion of accounting and reporting information, which, in turn, contributes to a decrease in the level of reliability of financial reporting. Therefore, the search for new approaches to solving the problem of comprehensive assessment of the reliability of information in the company's financial statements becomes important.

Analysis of recent research and publications. The issue of methodological support for assessing the reliability of information in the company's financial statements was studied by domestic and foreign scientists: Beneish M. D., Bezruchuk S., Chaika T. Yu., Dechow P. M., Gracheva N., Jones J., Kucheryava M. V., Marai A., McNichols M. F., Montier J., Plakhtiy T. F., Safonova I. V., Skrypnyk M. E., Tsaruk V. Yu., Vyhivska I. M.

Highlighting previously unresolved parts of the overall problem. However, significant scientific achievements in this direction, today in the professional literature the issue of assessing the reliability of information in the financial statements of the enterprise based on the models of J. Montier, M. D. Benish and M. L. Roxas, have not been widely reflected, which means the relevance research.

Formulation of the goals of the article. The purpose of the article is to assess the reliability of information in the company's financial statements based on the models of J. Montier, M. D. Benish, and M. L. Roxas.

Presentation of the main research material. The formation of reliable information in financial reporting is a form of feedback, thanks to which the subject managing the system receives the necessary information about its current state for the correct assessment of the financial state and detection of deviations from normative values [14].

For a better understanding of the essence of the concept of "reliable information in financial statements", it is necessary to establish what exactly is meant by the term reliability. In the reference literature, the concept of "reliability" is considered as a property of information to be perceived correctly; absence of errors; reliability of collected data; a justified form of the existence of truth; a belief that is based on knowledge and excludes any doubts [16, p. 11].

We believe that the concept of reliability of information in the company's financial statements should be considered in two ways: on the one hand, it is a financial statement that contains reliable, substantiated data, is characterized by the absence of errors and can be correctly perceived by users; and on the other hand, financial statements formed and compiled according to the rules established by legislative and regulatory acts are considered reliable.

The lack of a single interpretation of the reliability of information in the company's financial statements led to the development of separate approaches to its assessment, which have different names and methods of implementation. The authors refer to such approaches as qualitative, formal and indicative.

The use of a qualitative approach has gained considerable popularity in the works of T. Plakhtiy [12, p. 408-418]. The author analyzed a significant number of scientific sources devoted to the problems of assessing the reliability of information in financial statements, and proposed his own methodology, which provides for the calculation of single and integral indicators of reliability, based on the improved structure of the properties of the financial statements of the enterprise. Later, this technique was applied by S. Bezruchuk and D. Lozinsky [2] in relation to social reporting, which testifies to its universality and the possibility of its use not only for the financial reporting of the enterprise.

E. Sokolova [15, p. 360] developed a methodology for assessing the reliability of accounting and reporting information based on a combination of qualitative and quantitative features, N. Malinovska [15, p. 361] tested its own methodology for assessing the reliability of information in the financial statements of state and private companies. In addition, the scientist identified three reliability zones (reliable, semi-reliable, unreliable).

The application of a qualitative approach to the assessment of the reliability of information in the financial statements of an enterprise can be carried out on the basis of the use of various models and is based on the use of the concept of the reliability of information, regarding which there is no unity in interpretation among scientists. This is one of the disadvantages of using this approach in practical activities, since the lack of sufficient comparability of the obtained results is one of the communication barriers between management subjects and stakeholders. The advantage of the qualitative approach is the possibility of its application to various elements of the company's reporting (financial, social reporting, etc.).

The essence of the formal approach is to comply with the existing rules and principles of information formation in the company's financial statements. Within the framework of this approach, it is necessary to pay attention to the research of N. Grachova [5, p. 86], who proposed to evaluate the reliability of information in the quarterly and annual financial statements of joint-stock companies. O. Pokramovich considers the assessment of the reliability of financial reporting in the context of compliance with the norms of disclosure of accounting information, in particular, international standards of financial reporting, the use of which ensures an increase in the level of reliability [15, p. 334].

I. Safonova and A. Silchenko [13, p. 40] note that in addition to fraudulent actions and falsifications related to the violation of the requirements of accounting legislation as a result of dishonest actions, intentional twisting and distortion of the values of financial indicators, there is also the concept of concealment of information in the company's financial statements. Scientists claim that the veiling of information in financial reporting occurs when the requirements of legislative and regulatory documents are met, but deliberate distortion of individual items of an asset or liability is allowed due to a violation of accounting principles or the provisions of the company's accounting policy. However, I. Safonova and A. Silchenko do not indicate how the subjects of the accounting organization distort information in the company's financial statements.

Thus, according to the proposal of the representatives of the formal approach, the assessment of the reliability of information in the financial statements of the enterprise is reduced to the study of the procedure for compliance with the requirements of legislative and regulatory acts related to the disclosure of information and the availability of means of ensuring the reliability of its reliability. However, this is a rather superficial approach, as it does not include the need to check the reliability of the information disclosed in the financial statements of the enterprise, does not take into account the possibility of the entities of the accounting organization performing.

The most thorough studies regarding the reliability of information in the company's financial statements are available among representatives of the indicative approach, who have long-term experience in the empirical application of the developed models and a significant level of theorization of the studied issues, which determines the feasibility of such an assessment. However, even among the representatives of this approach, there are heated discussions about which of the models have the right to exist and have a better predictive ability in terms of predicting manipulations carried out within the accounting system. As A. Marai and V. Pavlovich [8, p. 34-35] note in this regard, due to the fact that earnings management practices cannot be the object of direct observation, as well as due to the existence of a significant number of methods that management uses for their implementation, it is rather problematic to identify them, which leads to the development of a significant number of models. As a result of an in-depth analysis of the models developed by representatives of the indicative approach,

P. Dehou, V. Gi and K. Shrend [4, p. 397-398] established 14 factors that can influence the implementation of manipulations, 9 proxy variables of earnings management and 8 consequences of the influence of the use of such practices, which together form a significant number of combinations for the development of models that would allow determining the existence of manipulations in the accounting system. The existence of a significant number of models for measuring the level of reliability of information in the company's financial statements is evidence of their imperfection and the need to synthesize existing knowledge in this field of research.

At the same time, within the framework of the indicative approach, certain types of models began to find more and more empirical confirmations and gained support from representatives of scientists in the field of accounting and economic analysis. Yes, by J. Jones [6, p. 211-212] a model of actual measurement of revenue management based on the use of regression analysis was developed. The scientist found a linear relationship between total accruals and the actions of company management in the process of implementing import operations aimed at reducing revenues. This model takes into account changes in non-discretionary accruals, which may be caused by changes in economic conditions or internal influence, which allows to isolate those accruals that were caused by the actions of the management of a particular company. The change in discretionary accruals occurs due to changes in sales volume, and in non-discretionary accruals - due to the sale of property and equipment of the enterprise. As noted by M. McNichols [9, p. 338], measures to detect accounting manipulation of earnings based on the J. Jones model or the modified J. Jones model are not powerful or reliable enough to assess earnings management behavior in many contexts that may interest researchers in the field accounting, standards developers or analysts.

In support of this thesis, the author cites a number of evidences that contradict the assumptions underlying the models built on the basis of the J. Jones model. As a result, he comes to the conclusion that in the future there will be greater potential and demand from scientists for models that provide for the calculation of financial indicators that confirm the manipulation of subjects responsible for the organization of accounting and the formation of information in the financial statements of the enterprise. The scientific knowledge obtained as a result of the development of such models can contribute to the improvement of the National Regulations (standards) of accounting, as it will allow to identify the most problematic areas of accounting, within which the formation of accounting and reporting information takes place, and in relation to which manipulations are most actively carried out. Such models include the models of J. Montier (C-Score), M. D. Benish (M-Score (8 variable) and M. L. Roxas (M-Score (5 variable)).

J. Montier's model, aimed at providing a general assessment of the reliability of information in the company's financial statements and exposing intentional misrepresentation. The name of the general indicator - C-Score - of the Montier model comes from the title of the author's work "Cooking the books, or, more sailing under the black flag" ("compilation of accounting registers") [10]. C-Score is the product of six indicators that characterize the criteria for assessing the reliability of information in the company's financial statements. J. Montier refers to such indicators: the rate of change of the difference between net profit and net cash flow (K1), the rate of change of the turnover ratio of receivables (in days) (K2), the rate of change of the turnover ratio of stocks (K3), the rate of change of the value of other current assets (K4), the rate of change in the level of depreciation deductions (K5), the rate of change in the currency of the balance sheet (K6). If the calculated indicator of the J. Montier model meets the criteria for assessing the reliability of information in the company's financial statements, then the value of the assessment is 1, if not - 0.

It should be noted that J. Montier's work "Cooking the books, or, more sailing under the black flag" ("compilation of accounting registers") [10] does not present a clear algorithm for calculating indicators that characterize the criteria for assessing the reliability of information in the company's financial statements. Therefore, the authors, taking into account the approved forms of financial reporting in Ukraine [11], proposed an algorithm for calculating the indicators of this model (table 1).

Table 1

Algorithm for calculating model indicators by J. Montier according to the information of the financial reporting forms of the enterprise in Ukraine

Indicator	Algorithm for calculating the indicator characterizing the evaluation criterion
K 1	$\frac{[(\text{line } 2350 \text{ (2355) form } 2) t - (\text{line } 3400 \text{ form } 2) t]}{[(\text{line } 2350 \text{ (2355) form } 2) t-1 - (\text{line } 3400 \text{ form } 2) t-1]}$
K 2	$\frac{[(\text{line } 2000 \text{ form } 2) t / (\text{line } 1040 + \text{line } 1125 + \text{line } 1130 + \text{line } 1135 + \text{line } 1155) \text{ column } 3+4 / 2 \text{ form } 1)] t / [(\text{line } 2000 \text{ form } 2) t-1 / (\text{line } 1040 + \text{line } 1125 + \text{line } 1130 + \text{line } 1135 + \text{line } 1155) \text{ column } 3+4 / 2 \text{ form } 1)] t-1}{}$
K 3	$\frac{[(\text{line } 2050 \text{ form } 2) t / (\text{line } 1100) \text{ column } 3+4 / 2] t}{[(\text{line } 2050 \text{ form } 2) t-1 / (\text{line } 1100) \text{ column } 3+4 / 2] t-1}$
K 4	$\frac{[(\text{line } 1195 - \text{line } 1100 - \text{line } 1040 - \text{line } 1125 - \text{line } 1130 - \text{line } 1135 - \text{line } 1155) \text{ form } 1) t]}{[(\text{line } 1195 - \text{line } 1100 - \text{line } 1040 - \text{line } 1125 - \text{line } 1130 - \text{line } 1135 - \text{line } 1155) \text{ form } 1) t-1]}$
K 5	$\frac{[(\text{line } 2515 \text{ form } 2) t]}{[(\text{line } 2515 \text{ form } 2) t-1]}$
K 6	$\frac{[(\text{line } 1300 \text{ form } 1) t]}{[(\text{line } 1300 \text{ form } 1) t-1]}$

Source: developed by the authors for [11]

Based on the hypotheses of J. Montier and the scientific research of M. V. Kucheryava, we note that:

- the growth of the K 1 indicator is a criterion for assigning the company's financial statements to the category of those for which there is a risk of information distortion. That is, there is a high probability of manipulation of the company's profit;
- indicator K 2 is an indicator that characterizes the efficiency of management of debtors' debts at the enterprise. At the same time, J. Montier, for the purposes of the developed methodology, determines that such a criterion as a significant increase in the duration of the turnover of receivables at the enterprise can be interpreted as an accelerated recognition of income in order to increase profit;
- the rapid growth of the K 3 indicator in the model of J. Montier indicates that the amount of expenses or sales may be underestimated in order to increase the amount of net profit. The reason for such manipulation of financial reporting information is an attempt to increase the indicators of the investment attractiveness of the enterprise in order to attract funds;
- growth indicators K 4 is a criterion that indirectly indicates the probability of distortion of financial reporting information. According to J. Montier, the main assumption regarding this indicator is the following: the company's management is aware that investors often pay attention to receivables and inventories and therefore can hide problems with other current assets;
- a change in the dynamics of the K 5 indicator, in particular its decrease, for the purposes of the specified model, is an indicator that the company is reducing depreciation deductions in order to increase the amount of net profit;
- the general growth of the K 6 indicator, according to the developer of the model J. Montier, is a reflection of another scientific hypothesis, the essence of which is that the purchases of some companies are deliberately increasing. The reason for this is the desire to increase costs and reduce the level of profitability of enterprises in order to avoid taxation [7, p. 88-89; 10].

The numerical limits of the generalizing C-Score indicator are 0-6. The maximum value of C-Score (6) indicates a high probability of falsification of information in the financial statements of the enterprise, the minimum value of C-Score (0) indicates the absence of violations of the reliability of information in the financial statements of the enterprise (absence or low probability of falsification) [10].

In our opinion, the interpretation of the calculated values of the generalizing indicator C-Score can be carried out using an interval assessment of the probability of disclosing inaccurate information in the company's financial statements (table 2).

Table 2

Assessment of the reliability of information in the company's financial statements according to the model of J. Montier (C-Score)

The interval of the generalizing indicator (C-Score)	Assessment of the reliability of information in financial statements of the enterprise
0	The probability of disclosing inaccurate information in the company's financial statements is absent
1-2	The probability of disclosing inaccurate information in the company's financial statements is low
3-4	The probability of disclosing inaccurate information in the company's financial statements is average
5-6	The probability of disclosing inaccurate information in the company's financial statements is high

Source: suggested by the authors

M. D. Benish's model (M-Score) is based on a system of indicators called "Map of normative deviations of financial indicators" [1]. The map of normative deviations of financial indicators includes eight indicators: daily sales in receivables index (DSRI), return on sales index by gross profit (GMI), asset quality index (AQI), revenue growth index (net income from the sale of goods, works, services) (SGI), depreciation index (DEPI), commercial and administrative expenses index (SGAI), accrual to assets (TATA), financial dependence index (LVGI) (formula 1).

$$M\text{-Score (8 variable)} = - 4,840 + 0,920 \times DSRI + 0,528 \times GMI + 0,404 \times AQI + 0,892 \times SGI + 0,115 \times DEPI - 0,172 \times SGAI - 0,327 \times LVGI + 4,697 \times TATA \quad (1)$$

It is believed that with M-Score < - 2.2, falsification of information in the company's financial statements is unlikely; at - 2.22 < M-Score < - 1.78 there is a slight risk of falsification of information in the company's financial statements; and with M-Score > - 1.78, there is a high risk of falsification of information in the company's financial statements.

Continuing the research of M. D. Benish, M. L. Roxas substantiated the need to shorten M. D. Benish's model (M-Score (8 variable) to 5 indicators, excluding SGAI, LVGI and TATA indicators (formula 2):

$$M\text{-score (5 variable)} = - 6,065 + 0,823 \times DSRI + 0,906 \times GMI + 0,593 \times AQI + 0,717 \times SGI + 0,107 \times DEPI \quad (2)$$

For the modified model of M. L. Roxas, the limit value of M-score is - - 2.76. With an M-score < - 2.76, falsification of information in the company's financial statements is unlikely, with an M-score > - 2.76, there is a high probability of falsification of information in the company's financial statements, and its reliability needs to be increased.

The main content and normative values of the indicators of M. D. Benish's model (M-Score (8 variable) are presented in table 3.

Table 3

Characteristics and normative values of indicators models of M. D. Benish (M-Score (8 variable)

Indicator	Normative value for:		Characteristics of the indicator
	honest companies	honest companies	
DSRI	≤ 1,031	≥ 1,465	An increase in the share of receivables in the total amount of sales compared to the previous reporting period may be evidence of exaggerated (accelerated) recognition of sales revenue in order to increase the amount of profit
GMI	≤ 1,014	≥ 1,193	A decrease in the level of profitability of the company's sales indicates the presence of an incentive (motive) to distort data on the amount of profit (in order to overestimate it and artificially increase the investment attractiveness of the company)
AQI	≤ 1,039	≥ 1,254	An increase in the proportion of long-term assets (for example, capitalization of expenses) other than fixed assets relative to the Balance Sheet (statement of financial position) indicates that the company may be deliberately deferring its expenses in order to increase the amount of profit
SGI	≤ 1,134	≥ 1,607	High sales growth rates are not in themselves indicative of earnings manipulation, but businesses with high sales growth rates are more prone to financial fraud as financial condition and capital requirements put pressure on managers to meet sales targets
DEPI	≤ 1,001	≥ 1,077	A sharp decrease in the share of depreciation deductions relative to the original cost of fixed assets indicates that the company deliberately increased the period of useful use of assets
SGAI	≥ 1,054	≤ 1,041	The rapid growth of disproportions in the ratio of administrative costs and sales costs to the amount of net income from the sale of products is evidence of an artificial increase (decrease) in the amount of profit
LVGI	≈ 1,037	≈ 1,111	An increase in financial leverage indicates the enterprise's dependence on sources of external financing. This may be an indirect indicator of the fact that, in order to meet the requirements of lenders, company managers manipulate financial reporting indicators
TATA	≤ 0,018	≥ 0,031	Reflects changes in working capital excluding cash and depreciation relative to all assets of the enterprise, that is, it characterizes the level at which income from accruals exceeds income from cash flows. If the value of this indicator is positive, then this indicates the importance of accruals in the formation of the company's income, which may be evidence of income manipulation

Source: formed by the authors for [3, p. 82; 7, p. 95-96; 15, p. 375-376;]

The proposed set of indicators (table 3) is designed to test the hypotheses expressed by M. D. Benish regarding the fact that enterprises overstate net income from sales of products (revenues) and the value of current assets or carry out overtime capitalization of expenses due to an increase in the amount of receivables, a decrease profitability of sales, a decrease in the quality level of used assets, an increase in net income from sales and accounting reserves.

By analogy with the model of J. Montier (C-Score), the authors proposed an algorithm for calculating the main indicators of the model of M. D. Benishch (M-Score (8 variable) and M. L. Roxas (M-Score (5 variable) to the approved forms of financial reporting in Ukraine (table 4).

Table 4

Algorithm for calculating indicators of the M. D. Benishch model (M-Score (8 variable) and M. L. Roxas (M-Score (5 variable) according to the information of the financial reporting forms of the enterprise in Ukraine

Indicator	Algorithm for calculating the indicator
1	2
DSRI	$\frac{[(\text{line } 1040+ \text{ line } 1125+ \text{ line } 1130+ \text{ line } 1135+ \text{ line } 1155) \text{ form } 1) t] / (\text{line } 2000 \text{ form } 2) t]}{[(\text{line } 1040+ \text{ line } 1125+ \text{ line } 1130+ \text{ line } 1135+ \text{ line } 1155) \text{ form } 1) t-1] / (\text{line } 2000 \text{ form } 2) t-1]}$
GMI	$\frac{[(\text{line } 2000 \text{ form } 2) t-1 - (\text{line } 2050 \text{ form } 2) t-1]}{[(\text{line } 2000 \text{ form } 2) t - (\text{line } 2050 \text{ form } 2) t-1]}$
AQI	$\frac{[(\text{line } 1300- \text{ line } 1195- \text{ p. } 1010) \text{ form } 1) t / (\text{p. } 1300 \text{ form } 1) t]}{[(\text{line } 1300- \text{ line } 1195- \text{ line } 1010) \text{ form } 1) t-1 / (\text{line } 1300 \text{ form } 1) t-1]}$
SGI	$\frac{(\text{line } 2000 \text{ form } 2) t / (\text{line } 2000 \text{ form } 2) t-1}{(\text{line } 2000 \text{ form } 2) t / (\text{line } 2000 \text{ form } 2) t-1}$
DEPI	$\frac{[(\text{line } 1012 \text{ form } 1) t-1 / (\text{line } 1011 \text{ form } 1) t-1]}{[(\text{line } 1012 \text{ form } 1) t / (\text{line } 1011 \text{ form } 1) t]}$
SGAI	$\frac{[(\text{line } 2130+ \text{ line } 2150+ \text{ line } 2180) \text{ form } 2] t / [(\text{line } 2130+ \text{ line } 2150+ \text{ line } 2180) \text{ form } 2] t-1}{[(\text{line } 2130+ \text{ line } 2150+ \text{ line } 2180) \text{ form } 2] t / [(\text{line } 2130+ \text{ line } 2150+ \text{ line } 2180) \text{ form } 2] t-1}$
LVGI	$\frac{[(\text{line } 1595+ \text{ line } 1695+ \text{ line } 1700) \text{ form } 1) t / (\text{line } 1300 \text{ form } 1) t]}{[(\text{line } 1595+ \text{ line } 1695+ \text{ line } 1700) \text{ form } 1) t-1 / (\text{line } 1300 \text{ form } 1) t-1]}$
TATA	$\frac{[(\text{line } 1195 \text{ form } 1- \text{ line } 1695 \text{ form } 1) t - (\text{line } 1195 \text{ form } 1- \text{ line } 1695 \text{ form } 1) t-1 - (\text{line } 1165 \text{ form } 1) t - (\text{line } 1165 \text{ form } 1) t-1 - (\text{line } 2515 \text{ form } 2) t]}{(\text{line } 1300 \text{ form } 1) t}$

Source: developed by the authors for [11]

To assess the reliability of accounting information according to the models of J. Montier (C-Score), M. D. Benishch (M-Score (8 variable) and M. L. Roxas (M-Score (5 variable), the authors used public information of the financial reports of PrJSC "Morshinsky Mineral Water Plant "Oscar" for 2015-2020 (table 5).

Table 5

Financial reporting information PJSC "Morshinsky mineral water plant "Oscar" for 2015-2020 (thousand UAH)

Indicator	2015	2016	2017	2018	2019	2020
<i>Balance sheet (statement of financial position) (form 1)</i>						
Assets (line 1300)	471 054	557 626	581 867	539 081	883 753	1 509 334
Residual value of fixed assets (line 1010)	214 325	285 835	308 278	298 039	320 207	684 083
Initial value (line 1011)	393 389	505 620	587 620	631 133	695 876	1 112 955
Depreciation of fixed assets (line 1012)	179 064	219 785	279 342	333 094	375 669	428 872
Reserves (line 1100)	51 479	67 553	90 299	127 659	106 669	153 257
Average annual cost of stocks (line 1100 column 3+4 / 2)	42 372,3	59 516	78 926	108 979	117 164	129 963
Receivables (line 1040+ line 1125+ line 1130+ line 1135+ line 1155)	116 840	96 222	57 507	12 708	150 830	53 790
Average annual cost of receivables (line 1040+ line 1125+line 1130+ line 1135+line 1155) column 3+4 / 2)	91 710,5	106 531	76 864,5	35 107,5	31 769	102 310
Cash and their equivalents (line 1165)	2 850	18 597	13 443	34 567	49 053	206 305
Current assets (line 1195)	171 863	183 931	174 478	190 381	306 552	413 352
Long-term liabilities (line 1595)	1 793	1 999	549	-	107 679	273 080
Поточні зобов'язання (line 1695)	3 080	134 362	170 347	119 248	139 935	457 849
<i>Statement of financial results (statement of total income) (form 2)</i>						
Net income from product sales (line 2000)	661 630	738 572	849 443	1 215 856	1 530 017	1 366 502
Cost of goods sold (line 2050)	544 527	635 682	777 587	1 077 315	1 164 355	1 055 574
Administrative expenses, sales expenses, other operating expenses (line 2130+line 2150+ line 2180)	29 130	41 507	48 872	78 790	108 797	83 163
Net financial result (line 2350)	75 985	58 786	29 711	65 519	232 833	142266
Depreciation (line 2515)	34 509	47 898	61 196	56 956	52 333	85 131

Source: calculated by the authors

Considering the data in the table 5, we affirm that the information in the financial statements of PrJSC "Morshinsky mineral water plant "Oscar" for 2016 and 2020 has no signs of falsification and violation of its credibility. In 2017 and 2019, there is an average probability of disclosing inaccurate information in the financial statements of the company under study. The value of the C-Score indicator in 2018 is 5, which indicates a high probability of disclosure of unreliable information in the financial statements of PrJSC "Morshinsky Zavod Mineralnyh Vod Oskar" and facts of its falsification.

The actual values of the M-Score indicator according to the basic model of M. D. Benish (8 variable) and according to its shortened version - the model of M. L. Roxas (5 variable) for PJSC "Morshinsky mineral water plant "Oscar" for 2016-2020. given in the table 6.

Table 6

The value of the M-Score indicator by models M. D. Benisha (8 variable) and M. L. Roxas (5 variable) for PJSC "Morshinsky Mineral Water Plant "Oscar" for 2016-2020

Indicator	2016	2017	2018	2019	2020
1	2	3	4	5	6
DSRI	0,734	0,521	0,162	8,962	0,398
GMI	1,273	1,635	0,746	0,447	1,048
AQI	0,878	1,076	0,553	3,094	0,938
SGI	1,116	1,150	1,431	1,258	0,893
1	2	3	4	5	6
DEPI	1,046	0,916	0,901	0,978	1,403
SGAI	1,273	1,027	1,137	1,094	0,859
LVGI	3,551	1,199	0,752	1,268	1,729
TATA	- 0,278	- 0,174	- 0,021	0,032	- 0,301
M-Score value according to the model of M. D. Benish (8 variable) (normal value -2.22)	- 4,704	- 3,315	- 3,231	5,686	- 4,701
M-Score value modeled after M. L. Roxas (5 variable) (normal value -2.76)	- 2,875	- 2,594	- 3,806	5,585	- 3,442

Source: calculated by the authors

According to the data given in the table 6, it is possible to establish the presence or absence of signs of falsification of information in the financial statements of PrJSC "Morshinsky Zavod Mineralnyh Vod "Oscar" for 2016-2020 according to the basic model of M. D. Benish (8 variable) and according to its modified M. L. Roxas (5 variable) option. Thus, based on the calculated values of the M-Score indicator and their comparison with the normative values according to the models of M. D. Benish (8 variable) and M. L. Roxas (5 variable), the company under investigation did not falsify information in the financial statements for 2016 -2018 and 2020, which is evidence of its reliability. On the contrary, PJSC "Oscar Morshynsk Mineral Water Plant" discloses inaccurate information in the financial statements for 2019 to satisfy its own property interests, which misleads both internal and external stakeholders of the financial statements due to a change in their perception of the financial results and profitability of the company under study .

Comparison of interpretations of the generalizing indicator C-Score according to the model of J. Montier, M-Score according to the model of M. D. Benish (8 variable) and M. L. Roxas (5 variable) regarding the reliability of information in the financial statements of the studied company for 2016, 2019 coincide, 2017 and 2018 do not (table 7).

Table 7

Comparison of the results of the assessment of the reliability of information in financial statements PrJSC "Morshyn Mineral Water Plant "Oscar" for 2016-2020, conducted according to the models of J. Montier, M. D. Benish (8 variable) and M. L. Roxas (5 variable)

Year	Value C-Score for model J. Montier	Value M-Score according to the model M. D. Benisha (8 variables)	Value M-Score according to the model ML Roxas (5 variables)	Availability misrepresentation of financial credibility enterprise reporting
2016	2	- 4,704	- 2,875	+ / + / +
2017	3	- 3,315	- 2,594	+ + / + / +
2018	5	- 3,231	- 3,806	- / + / +
2019	4	5,686	5,585	- / - / -
2020	2	- 4,701	- 3,442	+ / + / +

Note. Conventional designations: "+" - the probability of disclosing inaccurate information in the company's financial statements is low; "++" - the probability of disclosing inaccurate information in the company's financial statements is average; "-" - the probability of disclosing inaccurate information in the company's financial statements is high.

Source: compiled by the authors

Conclusions. It is worth noting that according to the results obtained on the basis of the model of M. D. Benish (8 variable) and M. L. Roxas (5 variable), the conclusions about the reliability of the information are more well-argued, since they are based on detailed calculations of indicators reflecting the relationship between the key indicators of the financial and economic activity of PrJSC "Morshinsky Mineral Water Plant "Oscar" (property status, liquidity, business activity, financial stability and profitability). Also, according to the specified models, it is possible to find areas where violations or distortions of reported data are likely to have occurred. Instead, J. Montier's model includes criteria that are mostly general in nature.

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FROM INFORMATION MANAGEMENT TO QUALITY: AN AUDIT PROCESS AND STANDARDIZATION FOR TAW COMPANY

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Key words: *Information Science, Information Management; Document Management; Quality Control.*

Introduction

The project that is presented took place within the curricular unit of The Final Project Seminar / Internship of the degree in Library and Information Science and Technologies (LIST) of ISCAP-P. Porto and was developed by a student finalist of this cycle of studies oriented by two faculty members and tutored by TAW staff. The project was developed at TAW, a micro-company focused on Information and Communication Technologies, seeking to associate best practices and technological solutions with all businesses. It is the Global Distributor of the platform called S2i, being specialized in its customization, project management and consulting in business processes (TAW, 2020).

The emergence and advancement of technologies, with emphasis on ICT (Information and Communication Technologies), Information Systems (IS), Quality Management Systems (QMS) and Information Science (IS), provide tools for organizations to be able to emerge in the market, and to manage, all the information and documentation that they generate and use, with the purpose of ensuring their quality through their standardization, organization according to normative processes.

The main objectives of the project are the promotion of Information Management (IM), processes, documents, projects and tasks in order to control and maintain all information documented, standardized and organized information, identifying and recording all events and documents considered relevant in the development of *software projects*. Thus, it is intended to contribute to the evaluation and certification process of TAW company and to prove, before future audits, compliance with the current regulations. The degree of freedom granted by TAW to the LIST internship student and project allowed a set of improvement proposals, namely the creation of Corrective Maintenance Forms and the preparation of the Quality Manual, carried out and completed.

Critical analysis of the problem

The identified problem, which originates the project, is the absence of IM procedures at TAW. Therefore, the main objectives are: the promotion of IM, processes, documents, projects and tasks in order to control and maintain all information documented, standardized and organized information, identifying and recording all events and documents considered relevant in the development of *software projects*.

All the work was based on literature review.

To solve the emerging need and problem of IM and documentation considered relevant for the development of software projects, and in order to achieve the objective of the project, it will be necessary to: a) execute a framework of the company and the S2i software to understand its functioning and deepen knowledge in this context; b) proceed to the process of selecting the most relevant information and functionalities and establish priorities; c) prepare Documentation Manuals and Use of Software with all the functionalities existing in each of the interfaces that constitute the Software of the Development area, in order to specify in detail each interface; d) group by modules the Documentation Manuals and software use and, in the system, organizing properly identified folders, promoting easy and fast access to all employees.

With regard to the problem of control and monitoring of projects and tasks, it will be necessary to: a) create Task Control Forms to record all tasks and events that will occur in the development of each project; b) participate in daily meetings with all project stakeholders, in order to control the evolution and updating of each and supervise the performance and work of

each team member; c) evaluate the time spent on each task; d) generate reports, using the database, that are important and accurate, dependent on the request of customers. Regarding standardization, it will be essential to fill out all forms and the improvement and creation of routes and classes in node.js to facilitate their location, update, and change, resulting in the time savings used to search for each interface since its source code will be represented in isolation. A Quality Manual was also proposed, which aims to present the company to stakeholders as well as its system and commitment to quality.

All proposed activities, with special emphasis on the creation of Documentation and SUM, task control and completion of forms consist of continuous activities that must be prepared and improved regularly to keep all the information and documentation updated and in coherence with the current situation of the company and the projects under development. Thus, it is essential to seek and implement improvements, as they contribute to and relate to characteristics that can define the quality of information and documentation. The project started on February 1st and expected to be fully completed on June 22nd of 2022.

Theoretical framework

The theoretical foundation focuses on the main themes of this project, namely IM information and document management, the most used and important archival standardization, information audit, quality management, relationship between archival standardization and quality management.

1. Information Management and Document Management

The theme under analysis makes it essential to identify and define some concepts, such as operational concepts that structure information and documents. The word information derives from the Latin *informatio* and refers to a communication process that aims to generate knowledge. This definition is in agreement with that defended by Capurro and Hjørland, who consider the word information in “two basic contexts [...]: the act of shaping the mind and the act of communicating knowledge.” (2007,p.155). In this sense, this concept is intrinsically related to communication. From the perspective of Information Science, it is defined as being “(...) a structured set of encoded mental and emotional representations (signs and symbols) and modeled with/by social interaction, capable of being recorded on any material support (paper, film, magnetic tape, CD, etc.) and, therefore, communicated asynchronously and multidirectionally.” (Silva,2006,p.25).

In fact, information has existed since the dawn of humanity and has always been present through language techniques, but it is today that information is seen as an essential phenomenon, becoming a “growing need for any sector of human activity (...) indispensable even if the search is not ordered or systematic, but results only from case-by-case and/or intuitive decisions.” (Braga,2000,p.1). Thus, and with the evolution and growth of the market, there is a need to correctly manage all available information, knowing how to use it and learning new ways of looking at the information resource, since no organization works without correct and organized information.

IM is increasingly relevant for a good performance of any organization, being a direct reflection of its management. Large amounts of information are involved in the business world, which, potentially, enhances its loss and consequently the difficulty in quickly and successfully access what is considered most relevant and useful IM encompasses “(...) dealing with, managing, finding practical solutions from the genesis to the multiplier effect of the flow of information, and comprises a diverse set of activities, namely: production, treatment, registration and storage, communication and use of information.” (Silva,2006,p.148), that is, IM integrates interconnected and linked activities, both in traditional and in computer information systems, with the aim of supporting the operations, control and functions of the organization and also “(...) identify and enhance an organization's information resources, teaching it to learn and adapt to changes.” (Tarapanoff,2006,p.22). In addition, it “groups organizational efforts related to value, cost, quality, origin, security, ownership, distribution, reliability, adequacy and relevance of information in support of the mission and objectives of a company.” (Oliveira,2014,p.37). It is a process of extreme importance, mainly because it is responsible for managing internal and external resources to the organization, supported by organizational policies that allow the interrelationship between the units and sectors of the organization, being, for this, necessary to mobilize different resources, more specifically, people, information technologies, information sources and services with the purpose of maximizing resources to share information in the best possible way, support the organization's global policy, support decision-making, support the evolution of the organizational structure and make knowledge of the surrounding environment more efficient and reliable.

Information is increasingly a source of wealth for organizations but, this information must be recorded and structured in documents so that it can be used whenever necessary, giving rise to the concept of document "(...) any document produced, received and kept as evidence and information by an organization, or person, in the fulfillment of its legal obligations or in the conduct of its activities." (APDSI,2014,p.14).

To retrieve and use information, it is necessary to implement document management. This term corresponds to the translation of the term records management being defined in the Portuguese Law No. 8.159 of 1991 as "(...) the set of procedures and technical operations related to their production, processing, use, evaluation and archiving in current and intermediate stages, aiming at its elimination or collection for permanent storage.", that is, it concerns the techniques and procedures used to organize the documents necessary for the proper functioning and management of organizations. In addition, it can be understood as the "administrative process that allows analyzing and controlling, throughout its life cycle, the recorded information that is produced, received, maintained or used in an organization, in line with its mission, objectives and operations." (Moreno,2008, as cited in Sena,2014,p.6).

For all the activities related to document management to be carried out in an efficient, consolidated, and organized way, it is necessary to develop support instruments, the so-called document management instruments, which refer to "documents or tools that are used in the course of an archival procedure or activity." (Pereira,2012,p.33), in which, according to the Portuguese Standard NP 4438:2, the main instruments used are the Classification Plan based on the organization's activities, the Archival Conservation Regulation and the security and access classification scheme (2005,p.15) giving main emphasis to the Classification Plan. However, the Portuguese General Directorate of the Book, Archives and Libraries, still stresses the importance of the Selection Table as a document management tool.

Related to this theme, from a technological perspective, the term IS – Information Systems – emerges, constitutes an "(...) operation unit that encompasses all the computer subsystems existing in the company for the most diverse purposes, and the functions that, in some way, are related to the treatment of information (...)." (Oliveira,2014,p.38). In this context, the importance of using digitalization arises, defined as the "(...) phenomenon of transforming analog data into digital language, which in turn can improve commercial relations between customers and companies, adding value to the entire economy and society as a whole." (Souza,2021,p.17). According to Santos and Miranda (2019), this process includes steps such as document reception, verification, preparation, capture, indexing, quality control/inspection/audit, reconstitution and return of the document and has advantages such as ease of access, reduction of unnecessary expenses, optimization of time, reduction of paper waste, increase of physical space and reduction of document loss.

For the Portuguese Association for the Promotion and Development of the Information Society (APDSI), document management presents as main objectives: the management of the entire life cycle of documents, covering all activities related to all moments of their management; the guarantee of efficiency and quality and their recovery as quickly as possible, ensuring that the recovery of documents is carried out in the most immediate and intuitive way and also the certification that the evaluation and selection of the documentation are carried out correctly and in a relevant way. to preserve the memory of the organization and all documentation with long-term administrative value (2014,p.13). So, document management should be considered a priority for organizations, as their management and decision-making are largely based on the quality and transparency of existing information accessible to all.

2. Archival Normalization

"At national and international level, there are standards that cover areas such as Information and Documentation: Management of archival documents, which are divided into direct principles, recommendations and general guidelines to be followed." (Montenegro,2017,p.16), that is, the good management of information and documents is guided by a set of norms - the archival norms - that aim to guarantee the ability to properly use information and documents, rationalizing investments necessary, without prejudice to the quality requirements, essential in the archive.

The ISO 30300 series of standards, a management system for archival documents, "(...) supposes the alignment of document techniques and processes with the methodology of management systems." (Ruesta,2012,p.6) and appears with the aim of integrating with other document management systems, allowing their interoperability, auditing, and certification. They can be implemented in any type of organization, since they all produce documentation in the development of their activities and have a very close relationship with other standards for the management of document records, particularly with those that were drafted by the ISO

Technical Subcommittee, called Archive/Records Management, whose coordination group is responsible for ensuring the consistency of all published standards.

From these, other standards have been developed that address different aspects of control and document management processes, highlighting: **ISO 15489- Information and Documentation - Records management**, transposed in 2005 to the quality system Portuguese (NP 4438:2005); **ISO 16175 - Information and documentation-Principles and functional requirements for records in electronic office environments**.

The use of these standards enables to "monetize processes such as storage, recovery and re-use [and] prepares the organization for any litigation or investigation by providing tools for carrying out such due diligence." (Duque,2021,p.42), facilitating the audit, evaluation, and crediting process.

3. Information Audit and Quality Management

With the growth of information and documentation and the recognition of the importance of its management and organization, there is a need to deepen the functions of their control and monitoring regarding the valorization, quality, development and proper functioning of any organization.

In this sense, the importance of audits arises as they correspond to the systematic, independent and documented process to obtain audit evidence (set of policies, procedures or requirements used as a reference against which audit evidence is compared) and respective objective assessment, with a view to determining the extent to which the audit criteria (a set of audit criteria requirements used as a benchmark against which objective evidence is compared) are satisfied (ISO 19011,2018,p.11). That is, it is the independent and documented process to obtain evidence and its evaluation, and to determine if the procedures, requirements or policies used are satisfied in the management of the organization, with the objective of evaluating its efficiency and effectiveness, and must, therefore, be performed by a technically prepared person – the auditor.

There are several areas to which an audit can be applied but we highlight in the words of Carneiro (2004,p.57) "information – the audit will focus on the organization of information systems, security and information flows".

In the context of the project, the importance of information auditing was highlighted because "regardless of the size of a given organization, its nature or its activity, the production of information is an integral part of its activity and allows for good management and continuity of your business." (Duque,2021,p.17) and how an audit is the "incorporation of information about a particular object, with the aim of making a deep review of the functioning or behavior of the object under analysis." (Ponjuán Dante,2008,p.6), then, "(...) obtaining information, its validity, its organization, systematization and analysis are phases or steps that occur throughout the audit process." (Ibidem,p.7), becoming indispensable tools for the good management of information and documents in organizations.

We look at information audit as a "systematic review of the use of information, resources and flows, with verification and reference to existing people and documents, in order to establish the extent to which they contribute to the achievement of organizational objectives." (Duque,2021, p.28), focusing on analyzing the information cycle and identifying user needs, assessing how effectively they are met, with the aim of making IS more effective and efficient. In other words, it is the process of "(...) discovering, monitoring and evaluating an organization's information resources to program, maintain and improve an organization's information management." (Dante,2008,p.9), being something essential to determine the value, the environment, the quality, the function and the usefulness of the existing information resources and to use them strategically, to identify errors and duplications and to facilitate the mapping of the flows of information.

The information audit goes through a set of seven phases and, according to Orna (2002, as cited in Pestana,2014,p.51), it evaluates the information that the organization has, the resources it has to make the information accessible, the way the organization uses the information to promote its ends, the people involved in using the information, the technical means that are used to work with information, and the criteria used in the organization to determine the cost and value of the information.

Nowadays "quality is an absolute necessity for organizations. It always has been and continues to be more and more as competition increases, the complexity of the world increases and change accelerates." (Costa & Silva, 2021,p.19). In this context, quality management and control emerge as an "important tool because it recognizes people's needs and sets standards to meet those needs, aims to maintain standards that meet needs and also aims to (continuously) improve standards." (Campos, 1999, as cited in Ferreira et al., 2016, p. 50).

Thus, quality becomes an element of great importance for the organization that intends to survive in the current competitive market (Ferreira et al., 2016 p.51).

In general, the term quality management refers to the set of techniques developed by organizations in order to properly train, motivate and compensate employees and also define, administer, establish and manage criteria and indicators to meet customer expectations, thus focusing on three basic principles: "focus on the customer and other stakeholders, involvement of all workers in achieving organizational goals, organizational action structured by processes and adoption of a scientific practice in knowledge management." (António et al., 2019,p.158). In addition to these principles, the ISO 9001 standard also adds leadership, relationship management, improvement and evidence-based decision making (2015, p. 8). Management is based on four activities that constitute the Deming cycle or PDCA cycle (Plan, Do, Check and Act) to "(...) ensure that its processes are endowed with with adequate and properly managed resources and that opportunities for improvement are determined and implemented." Pinto, 2017, p.7). This process of continuous improvement is applied in Quality Management Systems (QMS) that allow "to lead an organization to analyze the requirements (or needs) of the customer, define the processes that contribute to obtaining a product and keep these processes under control." (Leitão, 2010,p.108).

Thus, in the context of standardizing and "guiding the implementation of quality management systems in organizations, regardless of their sector, type or size (...)" (Pinto,2017, p.3), ISO published a series (ISO 9000) four standards for quality management. Throughout the project, the main standard used as a reference in all activities was the ISO 9001:2015 standard, as it provides organizations with a generalized model with the requirements for a QMS and is the standard most requested by organizations that intend to develop a process of quality certification that is the case in question, obtaining recognition derived from compliance with the requirements of the standard with an international impact.

4. The relationship between archival standardization and quality management

According to Silva, standardization essentially involves the rationalization of documentary circuits, administrative processes and procedures and, more recently, standardization and forms (2008, p. 9), being one of the most important forms, the Corrective Maintenance Form, which consists of the "correction of errors detected in the normal functioning of the system and that result from an evident failure in its implementation [being] this type of support, as a rule, provided by the elements that were part of the implementation team ." (Palhoto, 2016, p. 200) and also the Task Control Form, which is a way of "ensuring a correct perception of the current state of an iteration [being] essential that each team member manages the tasks for which is responsible." (Ibid., p. 126) and it should be done at the end of the working day and as soon as the task is completed with the objective of ensuring that the entire team is aware of the project, the tasks actually completed and carried out, the time spent in each task and the person responsible for each one. These forms are grouped in manuals, the so-called Form Manuals. This rationalization of forms favors the quality of documentary production and information that circulates in the company and that must be archived (Leitão,2010).

The same happens with the control of the procedure, where "(...) all the steps to be carried out in each phase of the processes, responses, decisions and transactions are defined and, consequently, recording, for each action, the expected execution dates and those actually fulfilled." (Leitão, 2010,p.11). Document control means that the organization knows all the documents that are part of the system, their status and makes it possible to ensure that customers have all the documentation they need at their disposal in the version more correct and updated (Antunes, 2011). It is also essential to control records, "documents that prove the performance of activities being produced by the performers of each activity. It is also the performers of each activity who are responsible for organizing them." (Antunes, 2011,p.89) according to archival regulations, making it essential for organizations to establish "(...) a documented procedure to define the controls necessary for the identification, storage, protection, retrieval, retention and destination of records." (Idem). So, "(...) the implementation of a quality management system requires an integrated articulation with the archival or document management system." (Leitão, 2010,p.114). The QMS will be more effective when it is articulated with the archive or information and documentation management policy, since it is based on documentation requirements, which requires a process approach.

Project Results

The first phase consisted of creating Documentation and Software Usage Manuals (SUM), related to a company's project, with a step-by-step explanation of all the functionalities of each module and each constituent interface. For the creation of each of the manuals, the

word processor Microsoft Word was used with the objective of being a means of easy editing and updating, starting with the elaboration of a demonstrative cover image of the referring interface, through the image manipulation and editing program. Paint.NET and the Paint3D application, and then the step-by-step demonstration of all possible features with a short explanation, representative prints and routes. Furthermore, at the end of each manual, the DER (Entity Relationship Diagram) was displayed, prepared in Microsoft Visio, with the help of existing tables, as well as the corresponding UML (Unified Modeling Language), also prepared in Microsoft Visio to facilitate the reading and interpretation of the functionalities and actions possible to perform in each interface.

43 Documentation and SUM were created and organized by folders of the 3 existing modules, with each interface folder consisting of the respective complete manual, corresponding DER, and UML, saved independently to facilitate their editing whenever necessary.

Some errors were found so it was suggested to prepare a Corrective Maintenance Form to identify, record, organize and describe all errors, omissions, failures, or problems associated with its operation or deformation for future correction and resolution. The form was created in Microsoft Word processor with two large sections: Identification, with the record of who verifies and notes the problems or errors found, with the obligation to fill in the fields referring to the User, Responsible and Date of Last Modification; Evolution, where the found error is registered and located and a solution is proposed, being necessary to fill in the fields referring to Element, Module, Interface, Description, Solution and Status. At the end, a legend was presented to facilitate the identification of the elements, establishing a code for each of the elements considered relevant, in order to standardize the vocabulary and terms existing in the organization and in the project.

The next phase consisted of structuring and creating a uniform and common Task Control Form for all team members, in Microsoft Word, with the aim of controlling all the tasks performed in each of the projects and understanding how and by whom was performed, as well as the time spent on each of the tasks. The form was prepared according to a set of pre-defined requirements by the tutor that included mandatory parameters, namely: Identification data; Data of the task to be performed; Task evolution.

Data reports and requested information reports were also created through jsreport (report server that allows generating reports through JavaScript modeling mechanisms), essentially in pdf format. For this, the existing source code was used, only making changes to the data intended to be presented in the report and filling in the fields referring to each topic to be presented, according to the client's needs.

The next task focused on the software's programming, namely in the elaboration of routes and classes in node.js (JavaScript interpreter used in database applications) in SQL database (Structured Query Language, it is the standard language used to work with the databases). Using node.js, the data from the database was added to the programming so that an easy and cohesive connection could occur, and, on the final site, the tables of the MySQL database would appear interconnected. This entire process was carried out in the Visual Studio Code source code editor and consisted of an improvement of the existing code prepared by the tutor as a way to standardize the code and make it easier to read, always following the same scheme and giving rise to the routes, and also in the creation of independent classes for each one of the interfaces.

A Quality Manual was written using Microsoft Word and consisted of the specification for the company's quality management system. This document is no longer mandatory in the latest version of the ISO 9001:2015 standard, but it was considered relevant for the company's quality certification, because it allows its presentation to interested parties.

Conclusions

The development of projects during the LIST curricular internship aims to provide the student with tools that enhance theoretical knowledge at the level of professional practices, promoting the practical application and in a professional context of the knowledge obtained during the degree. It also made it possible to improve skills such as communication, perseverance, critical and team spirit and resilience, and essentially emphasize the importance of information and information and communication technologies in the organization and quality of information and documentation as they are means of facilitating the entire management. The work was based on the theory related to information management and document management, archival standards, information auditing, quality management, relationship between archival standards and quality management.

Companies that survive in the information economy are those that use and integrate technologies and information resources strategically to develop new products, find new markets and stand out in a positive and creative way. Thus, information is increasingly valued because it is in its content that the true knowledge that feeds society and the world in general can be found by allowing technological, scientific advancement and the sharing of ideas, giving more and more importance to its relevance and quality.

The focal point of the project was the organization and management of information and documentation, in order to standardize the work processes, archiving, classification, retrieval and approval of information in a structured and centralized way, avoiding waste of time and information leakage and highlighting its quality. In addition, the importance of controlling projects, records and documents was also highlighted, as no organization works without documents, whether in physical or electronic format, and if there is no strict and recorded control of all documentation, companies end up losing the domain and the notion of what is really happening within the business environment and, thus, going backwards and not keeping up with the existing competitiveness. Regarding the forms, it would be extremely important to keep records, updates, and improvements to present.

As future work, the implementation and use of robotic process automation is recommended, since it allows replacing human tasks considered monotonous, routine, and repetitive, assuming a role of assistance to this type of tasks.

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