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MEDICAL ASPECTS OF SEA WATER INJURY

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ABBREVIATIONS USED

BAS	Bulgarian Academy of Sciences
BRC	Bulgarian Red Cross
CPR	Cardiopulmonary resuscitation
IAMA	Executive Agency "Maritime Administration"
ILF	International Lifeboat Federation
ILO	International Labor Organization
IMGS	International Medical Guide for Ships,
IMHA	International Maritime Health Association
IMO	International Maritime Organization
IMRF	International Maritime Rescue Federation ”
SAR	Search and Rescue
SOLAS	International Convention for the Safety of Life at Sea
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
UNHCR	United Nations High Commissioner for Refugees
VTMIS	Vessel Traffic Management Information System
WCOD	World Congress On Drowning
WHO	World Health Organization

CONTENTS

1. Introduction

Water injury is not a problem that can be solved, but a reality that cannot be ignored. The aquatic environment affects the human body in seawater with many specific physicochemical characteristics - density, pressure, temperature, chemical composition and biological factors. In a situation of maritime abuse, this impact can lead to serious settling, drowning, hypothermia and traumatic settling by the seawater itself or objects and materials in it. Survival of the adversity of the sea depends on both natural factors and the preparation, physical and mental in an attack in a poor situation.

Enrichment of public life and economy with the development of the maritime industry, transport, tourism, sports, etc. generate thousands in Bulgaria and millions worldwide potential victims of water injuries in the marine environment. Development of methods, both to reduce the damage to human health at the time of trauma, and to demonstrate assistance in continuous recovery and updating. A particularly important focus is the analysis of the risks for the rescuers themselves, in order to improve their training, maintained for competence and equipment. People from various categories take part in the rescue operations in case of a sea disaster: professionals - sea and water rescuers; professionals in other fields with preparation for showing assistance in case of accidents at sea, incl. and medical - police, firefighters, seafarers…. ; trained volunteers - members of voluntary teams at the Bulgarian Red Cross (DERBAK), voluntary structures at the Fire Protection of the Population, at municipalities, etc. organization; spontaneous volunteers, who are most often in close proximity to poverty.

The Bulgarian healthcare system has an established structure in the Black Sea region with opportunities to show qualified assistance in case of water injuries. The Bulgarian Red Cross (BRC), BULSAR, and the Bulgarian National Maritime Conversation (BNMS) successfully contribute to the counteraction to water injuries at sea.

2. Purpose, tasks and methods

Purpose

The purpose of this study is to analyze the marine casualties and catastrophes related to marine accidents and the health of those affected and on the basis of the conclusions to identify measures to reduce and overcome water injuries at sea.

Tasks

To achieve this goal, the following tasks are outlined:

1. To study, describe and analyze the situations of extreme impact of the marine environment on the human body and their possible manifestation in Bulgaria.

2. To analyze and summarize the accumulated medical experience from marine experiments for extreme residence in a marine environment. To plan and carry out new experiments.

3. To propose a model for studying the effect of living in an aquatic environment under normal and extreme loads. To determine the relevant equipment, perform research and analyze their results.

4. To analyze the medical training of all categories of participants in rescue operations and to identify ideas for increasing its effectiveness.

5. To propose new forms for the development of the systems for reaction and protection of the health of those affected by an accident with marine injuries.

The elaborations on the set tasks are presented in section **3. Own researches** as follows:

Methods

- Documentary and bibliographic method - search and analysis of 373 sources, divided into 347 on paper and 26 Web-based materials. Materials from the archives of the Regional Council of the Bulgarian Red Cross-Varna, from the funds of the library of the Medical University-Varna, from the funds of the library of VVMU, Regional Library-Varna, Museum of the History of Medicine, Naval Museum, Regional State Archives - Varna, digitized publications from networks, personal archives.

- Direct obtaining of reliable information from specialists with many years of experience on the subject through direct communication. For the purposes of the study, multiple meetings and discussions were held with leading specialists from various fields - participants in marine experiments, lifeguards with many years of experience, leading medical specialists in resuscitation, intensive care and hyperbaric oxygenation.

- Laboratory method - Measurements of anthropological and physiological parameters were performed on 240 volunteers from among marine professionals and working as such. The data are reported both in the norm and in a situation of loading in an aquatic environment imitating the provision of assistance in case of an accident at sea.

- Experimental method - Models of marine experiments have been developed in their medical part to objectify results and hypotheses. Volunteers were involved to report emerging physiological and psychological changes in the human body during experimental navigation and situational simulation of rescue activities in case of a water accident. Medical studies based on established models have been introduced and are underway.

- Survey method - in the period 2019-2020 492 volunteers from different target groups were surveyed with specially prepared questionnaires related to the issue of water injuries. The questions are of a closed type, clear, specific, without ambiguities, a total of six in number. The first four have a true "yes" or "no". The last two questions allow you to mark more answers without looking for gradation in them. The study was conducted in the cities of Varna, Burgas, Ruse, Shumen, Sliven and Valchi Dol. The main part of the respondents are pupils and students, as well as students in specialized courses of the Bulgarian Red Cross and VVMU. Special groups of respondents are active retirees, border police officers and voluntary blood donors.

- Graphical method - Figurative presentation of quantitative data was performed in order to effectively analyze the statistical data from other research methods. 28 graphs were prepared: 3 Linear with markers - show trends over time in evenly spaced categories; 11 Columnar with markers - present data arranged in rows for comparisons between elements; 4 Pie and ring diagrams - show the proportional size of the elements in a series to the sum of the elements; 10 100% overlay columns show columns that compare contribution rates.

3. Own research

Our own research on the topic examines the various aspects of marine water injuries (causes, mechanisms, medical damage) and the overcoming of medical injuries at different stages (prevention of injuries, actions during an accident, overcoming injuries in subsequent periods). Studies involve a long period of information accumulation and one of active experimentation, analysis and summarization in recent years.

3.1. Study of extreme situations at sea leading to water injuries on a global scale and their manifestation in Bulgaria

In general, extreme situations at sea by their origin can be divided into two main groups - natural and man-made (Latin anthropogenic). To the extent that this distribution cannot cover the whole spectrum, it is evident from the combined type of causes in many of the catastrophes.

Natural marine disasters

The Earth is a planet with a capricious and vulnerable climate, turbulent geological activity and is constantly exposed to cosmic influences (attractions from stars and planets, falling giant meteorites, etc.). Although modern science is advancing a lot, much of the behavior of these factors remains unpredictable. To these variables is added the increasing influence of human civilization and the unbalanced attitude to the potential risk of natural disasters.

A tsunami (Japanese: 津 波 or 형사) is a natural phenomenon, a series of unusually high and destructive sea waves caused by an underwater earthquake, landslide or volcanic eruption. Less often, a tsunami can be generated by a giant impact when a meteorite falls into the ocean. A tsunami is not a single wave, but a series of waves, also called wave trains. They can cross entire oceans without much energy loss. The 2004 Indian Ocean tsunami has traveled 3,000 miles (nearly 5,000 kilometers) to Africa, arriving with enough force to kill people and destroy buildings and infrastructure. Drowning combined with mechanical damage is the most common cause of death in tsunamis.

Table 1. Tsunami with more than 2000 dead in a gradation by year on the left and by number of victims on the right. Those marked with * also include people killed in an earthquake, c ** killed by a volcano and c + victims in neighboring regions.

year	month	date	location	number	year	month	date	location	number
365	7	21	Crete, Greece	5000	887	8	2	Niigata Japan	2000
887	8	2	Niigata, Japan	2000	157	2	8	Central Chile	2000
1341	10	31	Aomori Prefecture,	2600	169	6	7	Port Royal, Jamaica	2000
1498	9	20	Enshunada Sea,	5000	170	10	28	Enshunada Sea, Japan	2000
1570	2	8	Central Chile	2000	174	8	29	Hokkaido, Japan	2000
1605	2	3	Nankaido, Japan	5000	190	12	28	Messina Strait, Italy	2000
1611	12	2	Sanriku, Japan	5000	175	5	20	Northwest Honshu,	2100
1674	2	17	Banda Sea,	2244	192	9	1	Sagami Bay, Japan	2144
1687	10	20	Southern Peru	*5000	199	7	17	Papua New Guinea	2205
1692	6	7	Port Royal, Jamaica	2000	196	5	22	Southern Chile	2223
1703	12	30	Boso Peninsula,	*5233	167	2	17	Banda Sea, Indonesia	2244
1707	10	28	Enshunada Sea,	2000	187	5	10	Northern Chile	2282
1707	10	28	Nankaido, Japan	*5000	189	9	29	Banda Sea, Indonesia	*2460
1741	8	29	Hokkaido, Japan	2000	134	10	31	Aomori Prefecture,	2600
1746	10	29	Central Peru	4800	185	12	24	Nankaido, Japan	*3000
1751	5	20	Northwest Honshu,	2100	193	3	2	Sanriku, Japan	3022
1755	11	1	Lisbon, Portugal	*50000	194	11	27	Makran Coast,	*4000
1771	4	24	Ryukyu Islands,	13486	174	10	29	Central Peru	4800
1792	5	21	Kyushu Island,	14524	365	7	21	Crete, Greece	5000
1854	12	24	Nankaido, Japan	*3000	149	9	20	Enshunada Sea, Japan	5000
1868	8	13	Northern Chile*	25000	160	2	3	Nankaido, Japan	5000
1877	5	10	Northern Chile	2282	161	12	2	Sanriku, Japan	5000
1883	8	27	Krakatau,	34417	168	10	20	Southern Peru	*5000
1896	6	15	Sanriku, Japan	*27122	170	10	28	Nankaido, Japan	*5000
1899	9	29	Banda Sea,	*2460	170	12	30	Boso Peninsula, Japan	*5233
1908	12	28	Messina Strait, Italy	2000	197	8	16	Moro Gulf, Philippines	6800
1923	9	1	Sagami Bay, Japan	2144	195	11	4	Kamchatka, Russia	10000
1933	3	2	Sanriku, Japan	3022	177	4	24	Ryukyu Islands, Japan	13486
1945	11	27	Makran Coast,	*4000	179	5	21	Kyushu Island,	14524
1952	11	4	Kamchatka, Russia	10000	201	3	11	Tohoku, Japan	*+18453
1960	5	22	Southern Chile	2223	186	8	13	Northern Chile*	25000
1976	8	16	Moro Gulf,	6800	189	6	15	Sanriku, Japan	*27122
1998	7	17	Papua New Guinea	2205	188	8	27	Krakatau, Indonesia**	34417
2004	12	26	Banda Aceh,	*+227899	175	11	1	Lisbon, Portugal	*50000
2011	3	11	Tohoku, Japan	*+18453	200	12	26	Banda Aceh, Indonesia	*+227899
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The Bulgarian Black Sea coast is one of the most economically developed and densely populated regions of the country and the losses in case of unpreparedness would be catastrophic, especially in view of the damage to the health of the population. In the Bulgarian waters of the Black Sea there are potential earthquakes that could cause a tsunami. In the Black Sea, as in other seas, tsunamis can occur not only due to strong seismic phenomena, but also as a result of underwater landslides. More significant landslides and local tsunamis can be expected in the area between the village of Kranevo and the Golden Sands resort, between the localities of Trakata and Pochivka, around Cape Galata and on the abrasive nasal sections to Cape Emine inclusive. South of Cape Shabla the coast gradually rises and at Cape Kaliakra reaches 60 meters above sea level. The cliff is steep to vertical and actively abraded, which causes landslides or collapses of significant earth masses, especially during an earthquake (Agafonov BP, 1998). They could cause several meters of waves, which would be dangerous up to several kilometers from the landslide. The most probable future collapse can be expected on the eastern slope of Cape Kaliakra, which is partially undermined by the abrasion and separated by a vertical crypto-fault from the western part of the nose. Similar collapses can be expected on the western slope of the promontory, as well as on the steep or vertical cliff continuing west of Cape Kaliakra, increasing its height to 120 meters on Cape Chirakman near the town of Kavarna. Significant landslides with dangerous waves on a local scale can be expected around Cape Kalkanburun / Kalkantepe (on the maps it is also written as Cape Shield.), Behind whose cliff there are gaping vertical cracks, as well as in other places along the west coast to KK " Albena ". Earthquake activity on the territory of Bulgaria and its immediate surroundings is one of the most prominent manifestations of modern regional geodynamics. A state-of-the-art strategy to reduce seismic risk has not reduced the possibility of tsunami waves, and the increase in the population living along the coast increases fears of possible damage from water injuries in this type of disaster.

Tidal waves from hurricanes and sea storms are formed as a result of hurricanes and sea storms. They cause sea water levels to rise as a result of strong winds that push seawater to shore. This pressure is superimposed on the normal astronomical tide. The average water level can be exceeded by five or more meters. Storm-prone areas are coastal lowlands.

In 1928 a storm in the North Sea caused the so-called A "big wave" that raises the level of the River Thames. It flooded the areas of central London and 14 citizens lost their lives. After a quarter of a century in 1953, from January 31 to February 1, a strong wind over the North Sea caused a tidal wave that devastated the coastal areas of several North Sea countries. At London

Bridge, the water reaches its highest level and threatens to destroy the coast and flood central London. A total of 2551 people died, respectively 1836 in the Netherlands, 307 in England, 28 in Belgium, 19 in Scotland, 361 at sea (Pollard M., 1978; Cameron S., 2002; Kelman I., 2009).

The Bulgarian water area is characterized by a shelf with a relatively small depth. It is located between the contour of the modern coast and the ancient coastlines, located at a depth of 200 meters. The area of the separate morphological zones in this Bulgarian sector of the Black Sea is divided into a shelf – 12380 km2, a continental slope – 9380 km2, a continental foothill – 12970 km2 and a valley bottom – 8680 km2. The diurnal fluctuations at the level of the Black Sea are small. The solar tide is about 4 centimeters high, and the lunisolar tide is about 9 centimeters high. The waves in the Black Sea reach a height of 6-7 meters and a length of 90-100 meters. The length of the wind waves in most cases is 30-50 meters, but in case of dead waves it can reach 150-200 meters. In the Black Sea, non-periodic fluctuations in wind-related levels have also been observed - standing waves called seishi. Although the diurnal fluctuation of the sea level along the Bulgarian coast is several centimeters in size, the combination with a small coastal depth makes it risky for the formation of high waves in large atmospheric cataclysms. The two largest Black Sea cities, Varna and Bourgas, with a total of more than half a million inhabitants, are located next to the sea, at an average altitude of 10 and 20 meters, respectively. Taking into account these geographical features, the certain similarity of the regions of Varna and Burgas Bay with the conditions in the North Sea region is taken into account.

At the moment there is no reliable information about major crises with tidal waves caused by storms and hurricanes along the Bulgarian coast. The potential risk of such and related casualties should not be overlooked. The fact is that there are many cases with one or more victims of high waves affecting the coastal zone. On February 8, 2012, huge waves (about 5-6 in places up to 8 points) flooded the ports along the Bulgarian coast. People are dying in Burgas and Varna. There are such accidents in Sozopol in 2011, as well as in Durankulak and Varna in 2018 with several drowned children.

Freezing (icing) of sea water and ice drift.

During water crystallization, natural reservoirs freeze on the surface. Under normal conditions, fresh water freezes and melts at 0 ° C or 32 ° F (Fahrenheit). Salt causes the water freezing temperature to drop. The higher the salt concentration, the lower the freezing point. Sea ice is formed only in very cold conditions. It has a higher buoyancy in salt water than in fresh water.

About 15% of the world's oceans are covered with sea ice for part of the year. On average, sea ice covers almost 10 million square miles. The risk of health damage is huge. In the first place is the factor of low temperature, aggravated by exposure to cold water. Other possible injuries are mechanical injuries from hard ice, especially with the possibility of slipping.

The temperature of the maximum density of the water for the Black Sea is 0.5 ° C, and the freezing temperature is - 0.9 ° C. In the twentieth century, glaciation on the Bulgarian coast occurred three times - in 1929, 1942 and 1954, when ice blocks from the northwestern part of the sea, dragged from the south by a light wind and prolonged low temperatures, soldered and remained in the bays.

In icy seawater, the risks and medical damage are the same as those described for polar ice fields. The ship "Vanessa" with 11 people on board sank on January 3, 2008, 40 miles from the Kerch Strait near the Ukrainian port of Berdyansk. Hours earlier, one of the two watch officers on board sent a text message to his wife: "We're traveling on ice." Eight hours after the incident, Ukrainian rescuers found in the icy waters of the Sea of Azov only the very frozen mechanic and the bodies of two dead. 70 days later the waves threw the bodies of the other 7 Bulgarians and the Ukrainian pilot ashore.

Anthropogenic accidents

Man-made disasters at sea accompany all of human history. By default, shipwrecks are most commonly thought of, but there are many other critical situations at risk to human life and health that are defined as anthropogenic. With the increasing intensity of modern life, combined with the excessive complexity of technology, small mistakes or deviations easily upset the delicate balance and can lead to dangers for humans. Taking into account, as a criterion, the number of victims, it is appropriate to apply classification into two groups - crises with multiple victims and accidents with one or more victims.

Accidents with multiple casualties caused by human activity at sea are generally associated with large and heavy engineering facilities. Usually all those serving the facility and those present there are affected.

Maritime transport - When the phrase "Maritime Catastrophe" is used, the most common meaning is "Shipwreck". The explanation of the latter gives a Bulgarian dictionary - Sinking or wrecking of a ship due to storm or damage. The UN maintains statistics on more than three million shipwrecks that occur during the development of our civilization. In modern times, the

wreck of the Titanic is at the peak of public interest. The shipwreck on April 15, 1912 killed 1489 passengers and crew at sea.

The biggest tragedy in Bulgarian maritime history is the sinking of the 180-ton ship Struma, called by historians the "Bulgarian Titanic" transporting Jewish refugees to Palestine. The ship departed from the port of Constanţa with 769 passengers and crew on board. He reached Istanbul, where, due to disagreements with local authorities, Struma was not allowed to continue its journey or be repaired. Returning to the Black Sea in a tug, the defenseless ship was torpedoed by the Soviet submarine Shch-213 on February 24, 1942. 768 of the 769 passengers and crew on board died in the Black Sea.

In Bulgarian conditions in the area of the 330 km Black Sea coast there are now about 6-7000 small fishing boats, several hundred small sailing yachts and as many boats, an indefinite number of inflatable boats used by tourists camping on the beach, usually entering the sea to about 1-5 nautical miles and more. Depending on the season, at peak times at sea, about 700-800 vessels sail along the entire coast at the same time. The biggest maritime accident in our recent history was the sinking of the Bulgarian ship Hera on February 13, 2004. On the fateful day, the motor ship was stopped 7-8 kilometers before the Bosphorus by the Traffic Management Service to wait in The strait is closed, the wind speed was 90 km / h and the sea wave was 6 points. "Hera" overturned and sank in minutes without the captain being able to signal SOS. 17 Bulgarians and two Ukrainians 40 days after the tragedy, Turkish divers removed the bodies of three Bulgarians and two Ukrainians, and the remaining 14 sailors disappeared without a trace.

Table 2. Shipwrecks in the twentieth century with 500 or more deaths. The table does not include those affected by wars and combat operations and shipwrecks in rivers and lakes.

event	year	date	ship	flag	perished	survivors
collision with a tanker	1987	20 XII	Doña Paz	Philippines	4386	24 + 2
explosion	1948	4 XII	Kiangya	China	2750/3920	700-1000
collision with a ship	1949	27 I	Taiping	China	1500+	
collision with an iceberg	1912	14 IV	Titanic	Great Britain	1489/1503	706
reef strike	1991	17 XII	Salem Express	Egypt	1400	200
typhoon	1954	26 IX	Toya Maru	Japan	1153	
collision with a ship	1914	29 V	Empress of Ireland	Canada	1012	465
fire	1904	15 VI	General	United States	1000	

			Slocum			
typhoon	1912	22 IX	Kiche Maru	Japan	1000	
rock strike	1921	3 III	Hong Moh	Singapore	1000	100
rock strike	1927	16 IX	Wusung	Japan	900	
open door	1994	28 IX	Estonia	Estonia	852	137
blizzard	1939	12 XII	Indigirka	Soviet Union	741	28
cyclone	1902	6 V	Camorta	Great Britain	737	
stranded on the reef	1904	28 VI	Norge	Denmark	635	160
rollover	1947	17 VII	Ramdas	India	625	
fire and explosion	1981	27 I	Tamponas II	Indonesia	580	515
storm	1920	16 II	Afrique	France	568	34
overload	1993	16 II	Ferry Neptune	Haiti	500-700	

A special aspect of water injuries in maritime accidents is the hit of people in the water during hostilities. During World War II, many crew members of ships (military and commercial) and planes shot down over the sea died in cold water. Many wear life jackets, but retrospective analysis shows that the cause of death is cold (Guly H., 2011). This was the reason for a large experimental study of hypothermia in the Dachau concentration camp (August 1942 - May 1943) by doctors Holzloehner, Rascher and Finke. Its aim was to establish the most effective treatment for victims of hypothermia from immersion, especially members of the German Air Force crew who were shot down in the cold waters of the North Sea during the Battle of Britain (Berger RL, 1990). Subsequent developments on the subject in the United States and the United Kingdom (Molnar G.W., 1946; Anon. Hypothermia. Br Med J. 1953). In military operations when dropping aircraft into the ocean and drowning ships hit by torpedoes, those caught in seawater can also fall victim to shark attacks (Generous W. T., 2005; Lech Raymond B., 2000; Hillenbrand L, 2010).

Accidents at sea offshore facilities. There are many ways in which accidents can occur on mining platforms and other engineering facilities at sea. Fires are a major concern for employees of oil rigs. As with sailors on a ship, there is no easy way to escape when a fire breaks out and this can cause you to fall off the platform. Falling overboard in seawater can cause mechanical trauma, hypothermia or drowning. Non-fatal transport accidents can lead to hypothermia, bone fractures and injuries to the back, neck and head (Christou M. and M. Konstantinidou, 2012).

One of the worst accidents at sea that ever occurred was on July 6, 1988 in the North Sea on the oil platform Piper Alpha of Occidental Petroleum. Explosions and fires killed 167 workers. Only 61 people survived the accident (PatC-Cornell M. E., 1993).

Since 2003, a natural gas extraction platform has been installed 12 km from Cape Galata from

the Kavarna and Kaliakra fields in the Black Sea. At the moment, one incident was registered on January 30, 2018, after which a fishing vessel tore with a trawl, the so-called. control line on the bottom valves of the gas extraction installation. No people are affected. The development of the marine extraction and other marine industry will in future involve more and more people and the risk of marine injuries will inevitably increase.

Major accidents on the coast and marine facilities. On the morning of August 25, 2017, a bus with workers at the newly built cargo terminal of Tamanneftegaz in the Temryuk district of Kuban fell into the sea. 17 workers died in the waters, and one later in hospital. There are 33 people with various disabilities.

The greatest modern tragedy of this type in Bulgaria is the one that happened on November 7, 1978 on the pontoon-pedestrian bridge in the village of Beloslav. The village is divided on both shores by a deep-water shipping canal connecting Varna with Beloslav Lake. A temporary road connection has been established after the interruption of the existing bridges and until the commissioning of the ferry by means of a mobile pontoon bridge for pedestrians. The homes of the people of Beloslav remain on one side, and the railway station and the main roads to the district - on the other side of the canal.

On the day of the tragedy, hundreds of locals and guests at an ongoing fair took the canal to pick up the train at 6 p.m. The pontoon-pedestrian bridge sags, loses stability, tilts to the side and remains submerged. All passers-by pour into the icy waters. The crews of the ferry's motor boat are helping the hundreds of people in the flood. Dozens are lucky to be the rescuer from Varna, marathon swimmer Dobri Dinev, who saved the lives of 43 people from drowning. The final number of victims in this tragedy is 65 people.

Accidents with one or more affected. All seafarers and other seafarers are potential victims of water injuries.

Shipwrecks. The daily activities of sea workers pose many threats to their safety. In addition to the dangers of the ship, equipment failures and the risks of collisions, even small slip and fall accidents can have serious consequences when outdoors. A major health risk for both crew and passengers is falling overboard in seawater. It can be combined with trauma and / or loss of consciousness, which further complicates the situation. In addition to inhaling water into the lungs, severe injuries to the ship's hull and injuries to propeller wounds, debris in the environment and collisions with the water surface itself are added. Depending on the temperature of the water, "immersion syndrome" can occur - a shock of cold water causing a cardiac

arrhythmia and a block of the heart muscle. A recent report by OSHA (Occupational Safety and Health Administration) concluded that falling overboard or drowning was the second leading cause of death for sea workers, with most victims failing to save their lives during the fall. The chance of survival is tied to whether someone witnessed the accident. Timely intervention and removal of the victim reduces injuries and the risk of loss of life.

The incidents continue to accompany the maritime practice of Bulgarian seafarers and the risk of water injuries is throughout their professional lives. On January 2, 2020, two sailors - Bulgarian citizens - fell in the Norwegian Sea behind the cargo ship "Stara Planina". The bodies were not found.

Accidents at offshore mining and other engineering facilities. The offshore mining industry is a dangerous business. The combination of heavy marine fuel engines poses a huge risk of accidents on oil rigs. A crane operator on the Stena Drilling rig Stena IceMAX fell into the waters of Las Palmas Bay on October 21, 2017. He was pulled out of the water and emergency medical procedures were immediately initiated, but his life could not be saved. Similar accidents occur when transferring ropes between the platform and a service ship, when sea workers are on the edge of the facility, during construction and repair work, etc. An incident on the Galata gas production platform, which occurred on January 30, 2018, although without affected people, shows that the potential risk of water injuries related to offshore facilities on the Bulgarian coast should not be underestimated.

Accidents in coastal waters during bathing and swimming occur throughout the year and at all hours of the day and night. They are most common in the warmer seasons, when people use the water for relaxation and relief from the heat, with the 24-hour peak from mid to late afternoon. People are usually more tired and less able to make good risk assessments, and the extra workload of the region's typical lunchtime diet, alcohol and / or other intoxicants is added. Most drownings occur outside the perimeter of protected areas and during rescuers' off-hours. There are also those that occur in circumstances where the victim does not intend to enter the water. Young children aged 2 to 4 have a higher risk of drowning than any other age group.

Bulgaria covers only 110,994 square kilometers, but its natural and cultural resources make it a preferred destination with an impressive variety of types of tourism and significant potential for its development. Our country has 378 kilometers of Black Sea coast, over 209 beaches, picturesque bays and dunes. The vast majority of foreigners visiting the country come to Bulgaria for sea tourism, especially in the summer months, June-September. According to the

National Statistical Institute, the relative share of this period is 58.8% of the total number of foreigners entering Bulgaria. The tendency is for this fight to increase, and from there to proportionally increase the risk of water injuries on the beaches and coast of the country. The situation is similar with Bulgarian tourists. The traditional preference for holidays in seaside resorts is not only maintained but also increased.

Accidents in sea sports and entertainment. Nearly 70% of Europeans spend their holidays on the coast, mostly visiting other European countries, and 25% of these tourists travel with children under the age of 18. Drowning is the second leading cause of death in children in Europe. Tourists are probably more likely to suffer than locals because, on the one hand, they tend to take part in sports and activities that are unusual for them and, on the other hand, they are unfamiliar with the environment. The proportion of accidents involving British citizens traveling abroad, for example, has doubled in recent years, and falls and water sports are the most common causes (Cornall P., S. Howie, A. Mughal, V. Sumner, F Dunstan, A. Kemp, J. Sibert, 2005). In Europe, between 14,000 and 47,000 people are injured in water sports and boating every year. (Schmidt H-W., 2002). According to the National Transportation Safety Board / Personal watercraft safety, sport and leisure sailing leads to the highest number of deaths in transport after highway accidents and even exceeds the number of victims of aviation accidents. Worldwide, more than 355,000 people are injured annually in pleasure boats. More than 40% of accidents Injuries require treatment beyond ordinary first aid.

In the 21st century, Bulgaria, which is relatively backward in material and technical terms, is rapidly increasing these areas of maritime tourism and sports and entertainment activities. Coastal and navigable facilities - yachts, jets, etc. - are multiplying. and the potential risk of water injury accidents is increasing.

Underwater accidents. Diving offers an excellent window to the underwater world for all ages. Man entering the water is placed on the strong natural influences in an environment alien to him. Sensor systems are subjected to extreme loads. Coordinating swimming movements with snorkeling or breathing apparatus and the use of fins to move loads the vestibular, respiratory, circulatory systems and the entire musculoskeletal system. Today, diving is included in many aspects of modern public life, including: industry, sports, recreation and widespread strategic military objectives. Underwater activities are intensifying rapidly, creating permanent underwater installations that have specific research.

Free diving, although not at great depths and with a relatively short underwater duration, is

not at all safe. The most interesting objects of marine life are often seen near the rocks and reefs, which are home to dangerous species. In contact with them, injuries occur, which include small tears from rocks, corals and / or stings and injuries from larger marine life.

Small mistakes can cause serious injuries and even fatal ones. Understanding the physical properties of the underwater environment remains the best approach to minimize the risks of diving when respiratory support systems are needed (Pendergast D. R., C. E. G. Lundgren, 2009; Pendergast D. R., et al. 2015). The dangerous characteristics of immersion are: density, pressure, temperature and optical phenomena. Most diving accidents are caused by surfacing too quickly, causing decompression sickness or barotrauma. There are also non-dysbaric diving-related disorders, which include the effects of the aquatic environment - drowning, hypothermia and damage caused by equipment or related factors, such as carbon dioxide and carbon dioxide poisoning. General environmental conditions can also lead to another group of disorders, which include kinetosis (seasickness), injuries from marine organisms, intoxications from polluted water.

Professional diving is a dangerous sea job and, unlike recreational diving, usually does not involve calm or clear waters. The usual types of jobs for professional divers include working on oil rigs, building underwater pipelines, diving in coastal nuclear power plants or building and maintaining bridges, ports and power plants, which means using very large and heavy equipment. In addition to the equipment and construction conditions in which they work, professional divers spend a lot of time underwater with all the inherent risks of drowning, hypothermia, circulatory problems and poor visibility.

Underwater archeology is one of the youngest areas in archaeological research. As part of the old ancient world in the Bulgarian lands not only people lived, but also communicated and traded with distant lands, most often using shipping. Over the years, large parts of the coast, settlements and other objects of civilization remain under sea water. Excavations are carried out with underwater ejectors (introduced for the first time by the French side), which - in combination with the usual small tools - suck and clear the accumulated sediment from the finds leading to an increased risk of water injury.

Water injuries in aviation accidents occur in accidents while flying over the oceans and seas. There is even a specialized term for "flooding" to describe such incidents. When it comes, the people on board must be able to cope not only with leaving the cabins quickly, but also with

the risky aquatic environment. Air operators, airlines, aircraft manufacturers have created a streamlined system to reduce medical risk in a flood situation.

The conditions of aviation in Bulgaria are not distinguished by any clear specifics and the risk of aviation accidents involving elements of water injuries exists. The second and third largest and largest passenger airports in Bulgaria, those of the cities of Varna and Bourgas are located by the sea. They are surrounded by vast areas of sea water and large coastal lakes. The situation is similar with the small civil airports - those in Balchik and Primorsko. The number of flights of individuals, companies and departments is increasing. Their character is also changing - more and more sports and leisure flights are being purely transport. Apart from airplanes, they are increasingly carried out by paragliders, hang gliders, balloons and helicopters. Some of the military airports of the Bulgarian army are also located near the sea and coastal lakes. Such are the Chaika Naval Helicopter Air Base, located within the boundaries of today's Varna region of Asparuhovo and the Balchik Military Airport, which continues to perform defense-related tasks. In recent years, several aviation accidents have occurred in the immediate vicinity of the sea. Taking into account all this, the General Directorate "Civil Aviation Administration" at the Ministry of Transport and DG "Fire Safety and Protection of the Population" on 19.09.2019 for the first time organized an exercise to search and rescue in a plane crash with a crashed plane. It combines the actions of the components of the unified system for rescue and liquidation of the consequences in case of an aircraft accident to a water body. 22 organizations and structures are participating. The place for the imitation flooding of the crashed plane is the Varna Bay, 100-150 meters from the sandy strip of the beach in the Varna Asparuhovo district. Part of the plane depressurized in the air falls into the water, and the other part falls to land. The scenario for overcoming the consequences includes search and rescue in and under water.

Medical aspects of overseas migration. The migration of people outside their community was particularly pronounced in the second decade of the 21st century in the Mediterranean region. Europe is experiencing a historical refugee crisis on a historic scale, which has become one of the continent's defining challenges, with lasting consequences for humanitarian practice and regional stability. Crossing the Mediterranean is risky not only because of the unsafe vessels used for the purpose. Migrants are mainly from countries with tropical climates, poverty, low social status - poor, low nutrition, poor health status, lack of vaccinations, etc. Many refugees are unaccompanied minors, women, children and are vulnerable to both specific problems and water injuries. In the first six months of 2015, 137,000 migrants crossed the Mediterranean, traveling

in appalling conditions on unsafe vessels. In mid-April of the same year, 800 people died in the largest registered refugee shipwreck. For the thousands of migrants who continue to cross the Mediterranean, the risks remain very real (The sea route to Europe: The Mediterranean passage in the age of refugees. UNHCR. P. 14). In winter, there is a high probability that boats will turn into stormy seas and people will drown. The waves get higher and the wind is stronger, which increases the risk of water injury. While dehydration is predominant in summer, hypothermia is a serious threat in winter. The challenge for healthcare providers is to be prepared to treat many people with hypothermia at the same time.

The Bulgarian Black Sea coast is also subject to overseas migration with all the risks of marine water injuries for those crossing the sea. Two immigrants from Syria were pulled out of the sea during a rescue operation in the Trakata area near Varna on January 4, 2014. The water temperature is not more than 7-8 degrees. The Syrians are hospitalized in a serious general condition, with varying degrees of frostbite. On August 17 of the same year, 63 illegal immigrants from Afghanistan, Iraq and Syria, including 16 children, were captured by border police on a stolen Bulgarian yacht near Cape Shabla. They did not drink water for four days and did not consume any food. There are children in serious health condition, which requires their admission to a hospital in Varna for rehydration. In both cases, the main injuries are from hypothermia and dehydration. The occurrence of an accident with falling into the sea waters makes them potential victims of water injuries. Due to the barrier along the southeastern part of the land border of Bulgaria, attempts by migrants to reach from Turkey to Romania via the Black Sea are becoming more frequent.

In the implementation of activities under the first task, the following conclusions and summaries were reached:

1. Medical damage in accidents and catastrophes at sea not only does not decrease, but diversifies with new types and options.

2. Natural disasters are becoming more frequent and engaging, both due to the increase in the world's population and due to its great relocation along the shores of the seas and oceans.

3. Anthropogenic accidents increase their size and scope. More and more spectacular facilities are being created, both along the coast and far from the coast.

4. Passenger shipping, especially for recreational purposes, is already carried out on cruise ships with a capacity of more than 6000 passengers and a crew of more than 2000 employees. A typical crash of this type is the one on January 13, 2012 with the liner of the company Carnival

Corporation "Costa Concordia". The reason is passing through very shallow waters. The crash killed 32 people.

5. On the other hand, maritime tourism is growing rapidly. In 2019, the total number of tourist visits of foreigners in Bulgaria is 9311681. Most of them are on the Black Sea coast.

6. Sea sports, recreational fishing, professional and recreational diving are also growing.

7. The Republic of Bulgaria is not isolated from the global threat of maritime terrorism and overseas migration and related medical problems, incl. water injury.

Globally, the most massive cases of water injuries are associated with natural disasters, such as tsunamis following earthquakes in the world's oceans (Indonesia 26. 12. 2004. - 227899 victims). The risk of water injuries continues to be high in countries with low altitudes and rising monsoon seasons (10% of Bangladesh's territory is below 1 m above sea level). The leading anthropogenic causes are shipwrecks with passenger liners (Titanic 15. 04. 1912. - 1503 victims). A UN General Assembly resolution of 28 April 2021 lists 235,600 drowned each year. The Republic of Bulgaria, with its 354-kilometer Black Sea coastline, developed maritime transport, maritime industry and tourism, is threatened by all variants of maritime accidents and disasters, potentially leading to water injuries. The risk of such in the future is most significant in the field of maritime tourism and entertainment. Diversification of existing practices to limit it is appropriate. This should be taken into account in all public activities, both in the coastal areas and in the rest of the country, due to the increased interest in the sea by the whole population. The long-term systematic targeted activity of state, municipal and civil organizations maintains a positive trend of reducing water injuries, as in the last two years 2019 and 2021 the number of drownings has dropped below 100 (98 and 83 respectively), and according to the WHO standard 1.2 per 100,000 population.

3.2. Study of the medical needs in a marine experiment and development of a model for medical provision of such.

Marine extreme medicine is too complex, with many variations, and it would be extremely difficult to create an appropriate research design to assess every possible situation. The experience gained and the efforts to provide high-quality research, supported by the highest level of scientific evidence, require a flexible creative approach. Moreover, the determining factor in creating a model for a marine experiment is the safety of the participants and the researcher. It is extremely unacceptable to conduct high-quality controlled studies, with a risk to the health and life of the subjects.

The planning, preparation and conduct of any rescue operation must take into account the capabilities of the human body and the human psyche. There is no more reliable way to assess the physiological and mental potential of the body than to put it in a comparable situation. Documented marine experiments began nearly a century ago. In 1928, aviation captain Franz Romer crossed the Atlantic Ocean in a kayak. During the period 1950-1980, dozens of marine experiments were conducted around the world, which gave a strong impetus to the development of marine science, marine technology and marine medicine. The most significant contribution was made by the French physician Alain Bombard, who sailed the flat-bottomed inflatable boat "Heretic" in the Atlantic Ocean. The voyage takes place in 65 days without additional equipment - only compass, sextant, navigation books, first aid kit and photo accessories. Alain Bombard survives without food and without water, overcoming the trials of the ocean, eating only seafood. Throughout the swim, he monitors his condition and keeps diary entries. Putting himself in the conditions of a "man overboard", Alain Bombar aims to destroy the practice of stopping the search for the victims of a shipwreck in a week. With his experiment he proves that a person will not drown if he uses an inflatable rescue device. Consumption of plankton and raw fish can replace food and water. Thanks to Bombard, in 1960 the London Conference on Maritime Safety decided to equip ships with lifeboats.

Alain Bombard's research inspires seafarers - professionals, enthusiasts and researchers around the world. Jacques Yves Cousteau began studying full life underwater in 1962 with the underwater home "Diogen" - experiment "Precontinent-1". In the period 1960-1970 many other countries prepared their projects for underwater homes and conducted underwater experiments with aquanauts: USA, Italy, Great Britain, Japan, Bulgaria, Germany, Poland, Canada, USSR, Czechoslovakia, Cuba.

Table 3. Experiments with underwater homes around the world in the 60s of the twentieth century.

State	Experimental Underwater Home	year
France	Diogen	1962
	Precontinent-1	1962
	Precontinent-2	1963
	Precontinent-3	1965
Germany	Malter-1	1966
England	Glaucus	1965
Poland	Meduza	1966
Czechoslovakia - Cuba	Caribe	1966
Bulgaria	Hebros 1967	1967
Russia	Ichthyander	1966,1967, 1968, 1969
	Sadko	1966
	Sadko 2	1967
	Chernomor-1	1968
	Chernomor -2	1969
USA	Sealab-1	1964
	Sealab-2	1965
	Sealab-3	1969

Bulgarian marine researchers do not lag behind global developments and trends. Dr. Alain Bombar himself writes "And maybe my experience received the best response in Bulgaria." A sea underwater experiment was conducted with an underwater home "Hebros 67" designed by Dr. Garabed Tomasyan. In the summer of 1968, three enthusiasts from Varna - Vasil Kirov (teacher and lifeguard), Dimitar Nikitasov (doctor at the District Hospital - Varna) and Petar Stanchev / Uvaliev (journalist) became "voluntary shipwrecked". The pre-selected route is from Varna to the mouth of the Ropotamo River and back. At the end of the summer in 1970, the Research Institute of Oceanography and Fisheries in Varna (NIORS) together with VNVMU “N. J. Vaptsarov ”and ASO (Emergency Rescue Detachment) and LVSh (Diving School) at the Naval Base Varna, conducted an experiment with the underwater lodge“ Shelf-1 ”at the bottom near Maslen Nos. The crew of the underwater home consists of three aquanauts. He was evacuated for decompression to the pressure chamber on board the providing military rescue ship "Jupiter" through a camera-lift "NYV-100", designed by VNVMU "N. J. Vaptsarov ”and built in the Dockyard“ Naval Arsenal ”. The obtained results make it possible to make the appropriate analyzes to form recommendations for further marine experiments. The participants in the medical program of "Shelf 1" clearly state them in the reporting document:

• The preparation of the medical program requires at least six months, and this period is

necessary for theoretical and practical training of the medical team. This would lead to the selection of the most suitable methodologies according to the set goal and increase the accuracy of the obtained results.

• The main part of the medical program should be realized during the barochamber period of the experiment. This requires sufficient time and a large number of studies to obtain statistically reliable results. During the underwater period to perform only the most basic studies of the cardiovascular and respiratory systems. Electrocardiography should be considered as a mandatory element of research. In order to obtain stable results, it is necessary to introduce radiotelemetric methods

• In medical selection, a methodology should be used to determine the functional state of the respiratory system, as it bears the greatest load under hyperbaric conditions.

• During the research in a pressure chamber to create a microclimate that does not cause stress in the functioning of individual body systems. If this condition is not met, the frequency of the experiment is violated and many of the results are credible. As we do not have a special hyperbaric complex, experiments should be conducted with seasons with moderate temperatures for obvious reasons.

The longest experiment (12 years) on the issue of survival in extreme conditions in the marine environment is the Plankton Program. Its purpose combines the study of the psychophysiological state of man, the nutritional qualities of plankton, the possibilities for rescuing shipwrecked people and the means of rescue. The main goal is to examine the person placed in critically difficult conditions and relative loneliness. The questions he studies are:

1. How does the whole human personality react in extreme situations?
2. What are the possibilities for existence, mental and physical ability to work?
3. What are the relationships in the microgroup "husband-wife"?

Due to the situation that the participants were simultaneously examined and researchers, self-assessment tests were prepared by the head of the Bulgarian Aviation Medical Institute, Dr. Kiril Zlatarev. Maximum objective indicators were also used - anthropological measurements, force tensometry and physiological measurements. During all the expeditions, Papazov and his wife Julia volunteered in difficult conditions and limited food. Doncho Papazov lost 12 kilograms, and his wife Julia (Ju) - 6 kilograms.

Table 4. Tabular presentation of the marine experiments of Doncho Papazov

№	Name	year	participants	route
1	**Expedition "Plankton I"**	1970	Doncho Papazov.	Sozopol - Burgas Bay - Sozopol
2	**Expedition "Plankton II"**	1972	Doncho and Julia Papazovi	Varna - Sochi, crossing the Black Sea
3	**Expedition "Plankton III"**	1974	Doncho and Julia Papazovi	Gibraltar - Las Palmas - Santiago de Cuba, crossing the Atlantic Ocean
4	**Expedition "Plankton IV"**	1976	Doncho and Julia Papazovi	Peru - Marquesas Islands - Tahiti - Samoa - Fiji 14,000 nautical miles
5	**By yacht around Europe**	1978	Doncho, Julia and Yana Papazovi Simeon Idakiev, Boris Siriyski, Rumen Kostov, Petar Andonov	sailing around Europe 5000 nautical miles
6	**Expedition "Plankton V"**	1979 -1981	Doncho, Julia and Yana Papazovi	Sozopol, Gibraltar, Canary Islands, Martinique, Venezuela, Curacao, Panama, Ecuador, Tahiti, Tonga, Rarotonga, Fiji, New Guinea, Torres Strait, Austria in Mauritius, Reunion Island, Durban, Cape of Good Hope, Cape Town, Saint Helena, Brazil, Azores, Gibraltar, Ceuta, Algeria, Istanbul, Sozopol 42,000 nautical miles
7	**Expedition "The Impossible Road"**	1988	Doncho Papazov	The circumnavigation of the circumnavigation entirely south of 40

A diary is kept in which both researchers record their observations and impressions equally. At least half of the content of the text refers to the health of the experimenters in physical and psycho-emotional aspect. These data, currently documented, are an extremely objective source of information on the medical aspects of survival at sea in a lifeboat. The records are hundreds and reflect specific events, injuries and damage from the marine environment in extreme conditions. The main aspects that are described are:

- Fatigue, exhaustion, sleep disorders
- Injuries and danger of such, incl. from shark attacks
- Diseases related to the unfamiliar marine environment
- Psychological exhaustion, apathy and other severe psycho-emotional states
- Diet, diet, affordable seafood in extreme disaster conditions and ocean survival

At the end of each expedition, participants undergo a detailed medical examination at the last port. The research attracts the interest and partnership of international organizations such as UNESCO and the Louis Malardé Institute (ILM). The experience gained serves as a model for a mixed crew for the international space program "Intercosmos".

Participants in a marine experiment should be presented with all the requirements of the regulated medical fitness of seafarers. At sea, they must have a medical certificate of fitness in accordance with Chapter Two, Section III of ORDINANCE № 6 OF 5 APRIL 2012 ON THE COMPETENCE OF SEAFARERS IN THE REPUBLIC OF BULGARIA, issued by the Minister of Transport, Information Technology and Communications. The very fact that the study is conducted under unusual conditions determines the need for participants to have passed the "Skills for first aid" National Standard of IAMA (Executive Agency "Maritime Administration"). In the case of an experiment on shore or water facilities, a mandatory condition is certification in determining the medical fitness for the respective activity. It should comply with the Ordinance on mandatory preliminary and periodic medical examinations of workers, the Law on Safety and Health at Work (OHS) and the specifics of national legislation and practices in the country. When conducting research during sporting events, the relevant medical certificates of those participating in sporting events should be provided.

The objectification of marine medical research requires the application of specific approaches and methodologies. Before examining the influences of typical factors, it is necessary to consider the limits of the norm. For the analysis to be true and comparable, the subjects must be situated in a controlled environment. In order for the research to be as objective as possible, the best option is for the measurements to be in situ, and for the equipment used to be mobile and resistant to humidity and other climatic influences.

The second aspect with extreme variability is the human body. There are no one or two parameters for a definite assessment, and it should be done comprehensively, taking into account the combination of multiple indicators. When determining the population to be studied, attention should be given as a matter of priority to persons at high risk of water injuries. They should be divided into subgroups according to the specifics of their activity and level of risk, which allows for comparison of results. At each subsequent stage to follow this gradation - from people at higher risk for water injuries to those with a lower level of risk.

Strict adherence to the established administrative procedures (positive opinion of the Commission for Research Ethics (KENI), Informed Consent, Personal Data Protection Procedures) ensure the proper conduct and reporting of research and recognition of results. Time situation is especially important in marine medical research in view of the multicomponent nature of the research process. In general, the following scheme can be used:

First stage

• setting goals and objectives
• initial equipment
• creation of an initial scientific team

Second stage

• development of an algorithm for the experiment
• organization of a specialized laboratory base
• first results of experimental research
• stage analysis

Third stage

• gathering a significant amount of data
• model optimization
• stepwise analysis
• summarizing all the information gathered, drawing the relevant conclusions and conclusions and creating useful models for implementation in perspective
• popularization of the results, analyzes and established good practices

In the implementation of activities under the second task, the following conclusions and summaries were reached:

1. The best way to accumulate scientific knowledge is to observe the processes in their natural development or, if that is not possible, to imitate them experimentally.

2. This is especially true in research in the field of extreme medicine and safety in critical environments and situations, incl. marine ones. Placing subjects and researchers in an environment with a real threat to their health and life and imitating the risk situation in a marine experiment is not a good way to obtain valuable scientific information on both physiological and mental reactions.

3. In Bulgaria there is a rich experience in marine experiments, most of which include medical research. The traditions in marine experimental activity are alive and their enrichment with new models expands the possibilities for medical scientific research.

4. New experiments are planned and carried out. They are developed, upgraded with new methods and technologies. These were carried out in 2019 and 2020-2021, and the results of medical examinations in them are presented in section 3.5. Results of own research in a marine medical research program.

5. The main asset of the research programs are the enthusiastic researchers and volunteers.

3.3. Creating a model for research in marine physiology, organizing a marine medical research laboratory and results of own research in a marine research program.

The human body responds quickly to changing environmental conditions with various physiological and cultural mechanisms. It adapts to a wide range of pressure, temperature and humidity so that cells and tissues receive enough oxygen, other substances necessary for metabolism and save lives. This ability allows survival in different regions of the world and successful living in humid tropical forests, harsh deserts, Arctic deserts and densely populated cities with significant pollution. The effects of the marine environment in many cases can exceed the body's normal adaptive capacity and cause damage and disease. However, there are very large differences in the specifics of a person's stay on the coast and on shore facilities, offshore facilities, vessels and underwater. The world's oceans are a huge challenge to civilization, and in order to continue its successful study and use, one of the directions is the study of the capabilities of the human body. Without such studies, marine research technologies (in engineering) would in themselves stop their development on a very limited perimeter. The fact is that practitioners of maritime professions and sports in most cases show much greater resilience to the effects of the marine environment and are less likely to become victims of water injuries. An excellent example of this are the Japanese divers AMA (Tamaki H, K Kohshi, T Ishitake, R M Wong, 2010) and the Korean divers Haenyeo (Lee JY, HH. Lee, 2014).

The studies may be targeted and focused only on physiological studies or be part of another marine experiment, and the study of the body's adaptive responses is an accompanying part of another scientific program. The situational classification of marine experiments is a huge variety of variants involving reactions of the systems of the human body in response to changing parameters of the marine environment. Extremely important are the studies of those exposed to extreme loads in a maritime disaster, accident or mishap. Particular emphasis is placed on research on the reactions, training and potential abilities of people providing assistance (professional and / or voluntary rescuers) to victims of water injuries. They are directly correlated with the issue of safety of the rescuer, expressed in three components

- Physical capacity
- Competence
- Mental resilience and courage

The thematic focus of marine physiology research should focus specifically on the study of changes in the human body in the aquatic environment and the psycho-emotional parameters of

marine incidents and rescue operations at sea.

Biomedical and medico-social research on human beings, using personal biomedical information are subject to standard operating procedures, guidelines and forms for assessing the ethical aspects of research in accordance with Bulgarian legislation, international acts and the principles of the Declaration of the World Medical Association. from Helsinki.

The most important characteristics of biomedical research are:

• safety of the examination, lack of trauma and damage to the examined object;

• high sensitivity, speed of sensors and recorders, possibility for synchronous registration of several indicators of physiological functions;

• possibility for long-term registration of the studied indicators.

• compliance with national and international standards;

• the small size and weight of the devices allow research not only in the laboratory environment, but also on site / in situ;

• the use of information technologies for recording and analysis of the obtained data, as well as for modeling of physiological processes. Spent on data recording and their mathematical processing, it is sharply reduced and it is possible to extract more information from the received signals.

The aim of the research is to study the adaptation mechanisms of the human body during the stay in the aquatic environment and the dynamics of changes in the bioparameters of adaptation in the body during training for a lifeguard or marine professional while monitoring the psychological aspects of the problem.

Selection of participants: Virtually everyone in modern society can find themselves in a situation of maritime accident and the associated risk of water injury. The level of this risk is taken into account when prioritizing research. Naturally, it is greatest among maritime professionals and especially among those whose professional specificity determines their role in maritime accident assistance activities. The first to be studied were professional lifeguards on the beach, those preparing for professional lifeguards in the BRC system, first and second year cadets of VVMU. In the expanding circle of potential subjects, other marine specialists follow, through various occupational or situational potentials affected by maritime disasters to those incidentally coming into contact with the sea.

When monitoring the studied anthropometric indicators, it is possible to assess the increase in the level of their physical readiness to meet the challenges of their professional realization and

their ability to cope with extreme situations related to water accidents.

Selection of methods: In the selection of methods, the determinants are those that carry information about the ability of the subjects to preserve their health and life in the marine environment and to provide effective assistance to victims of maritime accidents, disasters and accidents. The systems directly involved in this issue in the human body are the respiratory, nervous, cardiovascular and musculoskeletal systems. They are included as topics in the curricula and textbooks for training lifeguards and the International Medical Guide for Ships.

Anthropometric measurement of the human body can be an important indicator for assessing and comparing functional parameters. The morphological analysis is present in view of the individual differences of the examined persons. In medicine, anthropometry should always be applied taking into account gender and age. Anthropometric techniques are easy to implement, and the equipment includes an altimeter, scales, and a sewing meter for counting laps. The interpretation contains an assessment of the correlation between several important human sizes and physiological indications. In the study of marine professionals, some anthropometric measurements are not included, due to their low informative value for the specifics, and others are not socially or culturally acceptable. Through calculations, the collected data can provide information about the various components of body composition (water content, lipids), which are important for living in an aquatic environment and especially for activities in it. Nowadays, body composition components are measured by the rate at which a painless low-voltage electric current passes through the body or by a bioelectrical impedance analysis. The devices use other data - height, sex and weight - to specify the percentage of body fat. Properly used, this non-invasive approach to assessing body composition can quickly, easily and relatively cheaply provide accurate and reliable estimates of fat-free mass and total body water in healthy individuals. The expected values are used to automatically calculate the absolute and relative amounts of body fat.

The condition of the respiratory system is paramount to survival at sea. It has a direct bearing on both the buoyancy of the body and its functional capabilities in an extreme situation. Swimming is a sport with the deepest effect on the lungs. Numerous studies have shown that systemic physical activity and increased endurance lead to adaptive changes in spirometric parameters (Lazovic-Popovic B. et al, 2016). For the purpose of the study, it is useful to search for and establish such dependencies in marine professionals. Spirometry is a standardized, reproducible and most commonly used test for objective assessment of respiratory function

(Durmic T. et al, 2015). It allows more than 20 indicators to be measured in one sample at a time. Spirometric indicators that can be measured are: FVC, FEV1, FEV1 / FVC, FEV1 / VC, PEF, FEF25, FEF50, FEF75, FEF25-75, FEF75-85, FET, time to PEF, FEV0.5, FEV0. 5 / FVC, FEV0.75, FEV0.75 / FVC, FEV2, FEV2 / FVC, FEV3, FEV3 / FVC, FEV6, FEV1 / FEV6, FEV1 / PEF, FEV1 / FEV0.5, FIVC, FIV1, FIV1 / FIVC, PIF, FIF25, FIF50, FIF75, FEF50 / FIF50, VC, IVC, IC, ERV, IRV, Rf, VE, VT, tI, tE, VT / tI, tE / tTOT, MVV (measured), MVV (calculated). Oximetric indicators that can be measured are:% SpO2, pulse, total test time, T90% (SpO2 time ≤89%), T89% (SpO2 time ≤88%). The dynamics over time of their values provide information about the influence of the sea on the respiratory functions and volumes of marine specialists.

Functional breathing tests cover the measurement of ventilation and perfusion of the lungs and are complemented by blood gas analysis. Pulmonary airflow analysis is part of a set of automated breathing procedures. The main reason for performing gas exchange analysis is to obtain an accurate assessment of the ability to extract oxygen and use it for aerobic results. In addition to extracting oxygen, systems can also determine how much carbon dioxide is exhaled. The way oxygen and carbon dioxide are exchanged in the body (metabolic gas analysis) provides information on how the body copes with fatigue. The assessment of changes in oxygen uptake and carbon dioxide exhalation by the body is based on the fact that arterial levels are parallel to changes in respiratory metabolism and although not exactly the same in real time. The degree and time of reaction are determined with specially designed modules for fast and accurate analysis of the respiratory gases O2 and CO2. As the modules take samples of inhaled and exhaled airflow directly from the site, rapidly changing concentration levels are monitored. The common indicators used by gas analysis systems are:

Maximum oxygen uptake (VO2 Max)
Metabolic equivalents (METS)
Minute ventilation (VE)
Carbon dioxide (VCO2) production
Ventilation equivalent measures (VE / VO2 and VE / VCO2)
Respiratory gas exchange rate (RER)

Understanding the cardiac physiology of highly active people is critical to the safety of marine professionals. Physical activity leads to a significant increase in oxygen consumption (VO2), which is achieved by increasing cardiac output and arterial-venous O2 (AVO2)

difference. At rest, oxygen consumption is 3.5 ml O2 / kg / min, which is equal to one metabolic equivalent (MET). As activity levels increase, oxygen consumption increases to meet the energy expenditure required for a particular level of activity, which is achieved by increasing cardiac output and arterial-venous O2 difference. The rate of internal work, which depends on heart rate and blood pressure, refers to the myocardial needs for oxygen, which occurs at a given level of activity. As aerobic capacity increases, the need for myocardial oxygen to perform a particular activity may decrease as training levels improve.

Dynamic loading is characterized by repeated contraction and relaxation of large skeletal muscle groups, which requires an increase in oxidative metabolism and is achieved mainly by increasing cardiac output to ensure the delivery of oxygen to the actively contracting muscles. At dynamic loads, systolic blood pressure increases mainly due to an increase in cardiac output, while diastolic blood pressure either remains constant or decreases as a result of a decrease in peripheral vascular resistance.

In order to bring functional research as close as possible to the real situation of a maritime accident and rescue, a good approach is to conduct the research on site (in situ). The various loads during the training of lifeguards prepare the future marine professional for the physical and psychological aspects of a real rescue operation. Such an imitation is the only possible one because no one would allow an experiment risking human life and health. Hydro-resistant measuring bracelets are used for functional reading and analysis. For the success of the measurements, the relevant measuring instruments should be suitable for snorkeling and high-speed water sports and withstand a pressure equivalent to a depth of 10 - 40 meters. They make it possible to monitor different parameters by means of different sensors and sensors. A built-in heart rate monitor is available for 24/7 cardiac monitoring. With the pulse data collected by the device is able to estimate the maximum oxygen consumption and physiological age. It also tracks heart rate variability, which is used to calculate stress levels. The intense minutes for the respective training, the day, for the week can be traced.

This study provides valuable information on the capacity and ability to respond quickly and adequately in the event of an accident with water injuries. Speed is extremely important, especially in cases of endangered life and the time for intervention determines the life prospects of the victim.

Motor function is particularly stressed in the marine environment. Staying in the water puts the musculoskeletal system in a situation of increased ambient resistance with a significantly

reduced gravitational effect (Archimedes' law). Its good functioning is essential for saving one's own life in the event of a maritime accident and even more so in the case of at least double the load when assisting a victim. Hardware muscle testing is an easy and convenient criterion for objective quantitative assessment of muscle strength. For this purpose, dynamometers are used, which are applicable to study more than 20 muscular actions of the limbs and body. In order to perform it accurately, it is important to determine the position of the limb and the conditions for measurement (Mindova, S., I. Karaganova, 2014).

From the condition of the musculoskeletal system depends on the process of establishment and, above all, to maintain the ability to safely stay and provide assistance in the marine environment. Human buoyancy requires repeatable motor algorithms with a certain degree of monotony. In a crisis situation, it is necessary to solve difficult motor tasks for a short time with a particularly intense load on the self-management of the posture of the body and its individual segments. Swimming in seawater is much easier due to their salinity than in lakes and pools where the water is freshwater. In humans, it requires work with all muscle groups, especially those around the spine and the four limbs. The movements of the legs balance the position of the body in the water. They must be consistent in a vertical up and down direction. The knees are straight, the legs are in the spitz. The movements of the arms are circular, based on the centerline of the body along the length. One hand stretches forward, plunges into the water, passes under the body and exits into the back of the body, at which point the other hand begins the same movement. Swimming loads every big muscle in the body: legs - thighs, lower legs and pelvic muscles, abdominal muscles support the legs, upper limb - own muscles of the shoulder girdle with chest and back muscles included.

Muscle contractions can be examined with a combination of easily applicable and effective non-invasive methods - dynamometry and cEMG (skin electromyography). The latest generation electronic dynamometer has capabilities for storing and remotely transmitting digitized data. In the process of its commissioning, it was found that manual muscle testing gives deviations and is not precise enough for the purposes of the study of marine professionals. Therefore, a special device for objective measurement of muscle strength has been constructed. Through it, the dynamometer provides continuous digital force measurement, which greatly facilitates data processing. Mean strength, real-time strength, time to peak strength of the muscle under study, muscle fatigue time can be determined, and the results of up to 150 tests are stored simultaneously.

The flexibility of the joints and the angles of deviation in the movements in them are directly related to the navigable movements, ie to the ability to move and maintain a position in an aquatic environment. Measurements in the joints are important in survival in water and rescue activities in it. Electronic gonometry is used to measure the angles between the bones involved in joint connection. It can be used to determine the volume of movement in a joint. Based on these data we can judge the function of the specific joint studied. There is currently no gold standard for such a study. The digital goniometer uses laser hands and provides digital reading. It has zero risk for the test person, does not touch the skin, is compact and has extremely high accuracy.

Exercise during rescue activities leads to a decrease in body water - a state of dehydration. The additional loss of body fluid is due to the increased loss of sweat and lack of hydration during the action / training. Hypertensive dehydration is characterized by decreased plasma volume or hyperosmolarity of the blood> 300 mmol / kg (Edelman IS, J. Leibman, 1959). In extreme situations, decreased body water or hypohydration is followed by a jump in core body temperature, an increase in heart rate to compensate for reduced stroke volume and potential hypernatremia. This is followed by changes in cellular functions, including metabolism, agitation, hormone release, cell proliferation and cell death.

Blood osmolarity is considered to be the most common clinical measurement of hydration status, but in practice other less invasive measurements that rely on urine concentration are often used. Urinary Specific Weight (USG) using refractometry is an accurate and sensitive method for assessing hydration status in models for simulating a water accident assistance situation. In order for the specific refractometry study to be evaluated as a reliable method for dehydration and blood osmolality, study participants need to follow a specific protocol.

The integrated efforts and health of the pulmonary, cardiovascular and motor systems determine the potential of the individual. The assessment of functional capacity reflects the ability to perform activities that require sustainable aerobic metabolism. This provides important diagnostic and prognostic information for a wide variety of research models. This requires their function to be assessed comprehensively. The subject is loaded with a bicycle ergometer, measuring the following parameters:

1. Volume of oxygen consumed (VO2) and exhaled carbon dioxide (VCO2).
2. Respiratory volume (Vt) and minute ventilation (VE).
3. Heart rate and blood pressure.
4. Oxygen saturation (SatO2) and arterial blood gases.

There is ample evidence that combining multiple physiological measures provides greater power to discriminate against mental stress as well as other cognitive states. In order to be a full-fledged study, especially in its parts "analysis" and "synthesis", the functional physiological research should be supplemented and combined with a psychological one. Mental resilience along with physical capacity is the basis on which the professional skills of marine professionals are built.

• Psychological questionnaires are used to determine the level of resilience to stress and significant personal characteristics: anxiety, frustration, aggression and rigidity.

• The obtained results are compared with a comparable group.

• The initial results show a correlation between the maintenance of sports activity of the learners and their level of resistance to stress.

• The results of a comprehensive analysis of physiological and psychological data show the extent to which the willingness of marine professionals to engage in rescue activities in case of accidents at sea depends on their physical condition and the extent to their confidence gained in training.

A parallel study with experimental animals provides valuable information, with zero risk to human life and health, especially in areas and experiments that are conducted for the first time. He has gained experience from such experiments in the field of hyperbaric oxygenation, which is a specific medical field in the field of marine medicine. Based on it, an experiment of water trauma with Wistar white rats in extreme water environment was constructed and the reactions of stress in them were studied.

The created model of functional assessment of marine professionals has a dynamic character, as in the process of implementation of the MASRI project it is subject to optimization and upgrading. However, it claims to be established as an example of good practice in the promising direction of marine research.

The strategic goal is to overcome the negative experience of failed medical research in marine experiments. Data from medical studies in the marine environment are the basis for optimizing the training of marine professionals and especially those with increased occupational risk - water and marine lifeguards, sailors, fishermen, workers on offshore platforms, and athletes in water sports. There are various methodologies developed to understand the impact of the complex marine environment on the human body. This can best be achieved through functional research with specially prepared equipment, taking into account the various aspects of

the issue.

The Medical University "Prof. Dr. Paraskev Stoyanov "in Varna is the first university in the country to develop interdisciplinary marine medicine. The development of a scientific program in marine medicine began in 2019. Until then, research in this area is isolated and at the initiative of individual researchers - enthusiasts of marine medical science.The scientific issues are realized thanks to the participation of MU-Varna, as a partner in the program "Infrastructure for sustainable development in the field of marine research, linked to the participation of Bulgaria in the European infrastructure (Euro-Argo)" - (The establishment and operation of the Marine Medicine Laboratory is part of - the fourth module "Research Laboratory Complex" of the infrastructure, which is part of the NATIONAL ROAD MAP FOR SCIENTIFIC INFRASTRUCTURE (2017-2023) The other three thematically combined scientific the modules are:

1. Research fleet;
2. National Operational Marine Observation System;
3. High-performance computing complex;

Each of them is a functionally differentiated part of the scientific infrastructure and consists of separate elements, physically distributed in different scientific organizations in the region of Varna. The modules include: scientific equipment, facilities, databases, specialized scientific laboratories and centers connected in a computer network and necessary for the scientific community to conduct modern, high quality and competitive research, transfer, exchange and protection of scientific knowledge.

Table 5. Time schedule for establishment and operation of a marine medicine laboratory in coordination with MACRI activities.

№	Activity / Years	2019	2020	2021	2022	2023
1	Preparation of terms of reference / conceptual design					
2	Elaboration of a project for an experimental laboratory complex					
3	Construction of the laboratory complex					
4	Training, advanced training of the scientific staff					
5	Carrying out experiments in marine physiology related to the safety of marine activities.					

№	Activity / Years	2019	2020	2021	2022	2023
7.	Training of students in various medical specialties					
8.	Training for PhD students					

The model of a marine medicine laboratory should adhere to a series of formal and at the same time significant requirements / prerequisites.

- To be close to the sea in a seaside town with many sea professionals and other people visiting the sea and the coast.

- To be integrated in healthcare and scientific institutions. To have communication with the maritime business, maritime tourism, maritime sports and public organizations related to maritime issues.

- To ensure the safety of workers and subjects - emergency exits, fire protection devices, emergency equipment (defibrillator, AMBU….)

- To be equipped with equipment for anthropometric measurements, spirometric measurements, Computer ECG, dynamometer, bicycle ergometer and the corresponding configurations for data transmission and computer processing of information.

Of particular importance for the laboratory of marine medicine is that all devices are waterproof, easily portable, mobile, to be able to be used in situ (on site) due to the specificity of physiological research in the marine environment. This ensures maximum reliability of the results obtained.

At present, the laboratory at MU-Varna is equipped with the main part of the necessary research instruments and apparatus. The other necessary components are in the process of delivery. The scientific program starts and the first results and analyzes are ready and presented to the scientific community.

The objectives of high-performance marine research are to increase knowledge about the impact of the marine environment and to implement maritime policy and maritime spatial planning to achieve UN Goal 14 for Sustainable Development: “Conservation and sustainable use of the oceans, seas and marine resources for sustainable development. “With the capabilities of modern equipment and methods, a field is provided for studying the problems of marine physiology, hyperbaric medicine, diving medicine, marine toxicology, marine telemedicine, water rescue, emergency in marine accidents and the effectiveness of training marine professionals.

The performed experimental researches are aimed at:

- Research and assessment of the specific impact on the human body of the various factors of sea water - physical, chemical, biological and others.

- Study of the changes in the human body when entering and staying in the marine environment.

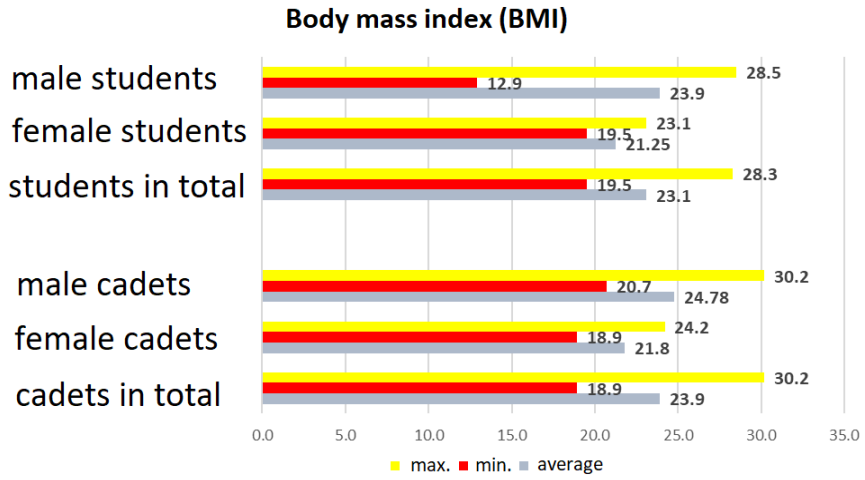
- Study of the physiological aspects of the residence of a marine facility.

168 volunteers were involved in fulfilling the goals of the scientific program in part and of functional physiological and psychological research for the period 2019-2021. All are persons professionally engaged in the marine environment. The predominant part are cadets from VVMU and Students from the Lifeguard training courses conducted by the Bulgarian Red Cross-Varna. Practical professional lifeguards on the beach also take part in the research. On the one hand, they are at the highest risk among the population of falling victim to a maritime accident. On the other hand, they are the most probable participants in rescue operations, incl. and providing medical assistance to victims at sea. Good preparation: physical, mental, methodical and theoretical would lead to great success and many lives saved. This is empirically proven and documented: Hristina Hranova saved the lives of 54 drowning people in the early twentieth century, Dobri Dinev personally saved the lives of 43 drowning people in the accident on the pontoon bridge in the town of Beloslav in 1983. In the future, the perimeter of the subjects will be expanded to include sailors, marine researchers, marine athletes and employees of the maritime industry and infrastructure.

Before starting functional measurements, anthropometry is performed as a basic research method. By taking into account gender, measuring height, weight, chest circumference, measuring skin fold, it is possible to compare the results obtained. The goal is an individual approach and reduction of the relative error in conducting research (Toteva, M., 1992). The analysis envisages taking into account the exceptional variability of the human body. There are no one or two parameters for a definite assessment, and it should be done comprehensively, taking into account the combination of multiple indicators. The calculation of the percentage of body fat and muscle mass is added to the algorithm of anthropometric research.

Of interest are the measured values and their comparison by different groups of seafarers. The present study started with comparable groups of students from the training courses for lifeguards at the Bulgarian Red Cross-Varna and cadets from the first year of VVMU. The average age of the students is 19.8 years and of the students is 19.6 years. The gender ratio in

both groups is 30/70 women / men. The average height of the students is 176.7 (160-186) centimeters, and of the cadets is 173.2 (160-182) centimeters. The average weight of the students is 71.1 (50-95) kilograms and that of the cadets is 72.4 (50-1000 kilograms) The comparison shows a minimal difference. in the two measured parameters and this is reflected in the subsequent calculations.The average body mass index (BMI) of the students is 23.1 (19.5 -28.3) and of the cadets is 23.9 (18.9-30.2) .In both studied groups the average value is in In students there are two values (≈20%) above the defined norm of BMI 25. In cadets of the 1st course 8 (≈ 50%) although slightly higher than the norm.

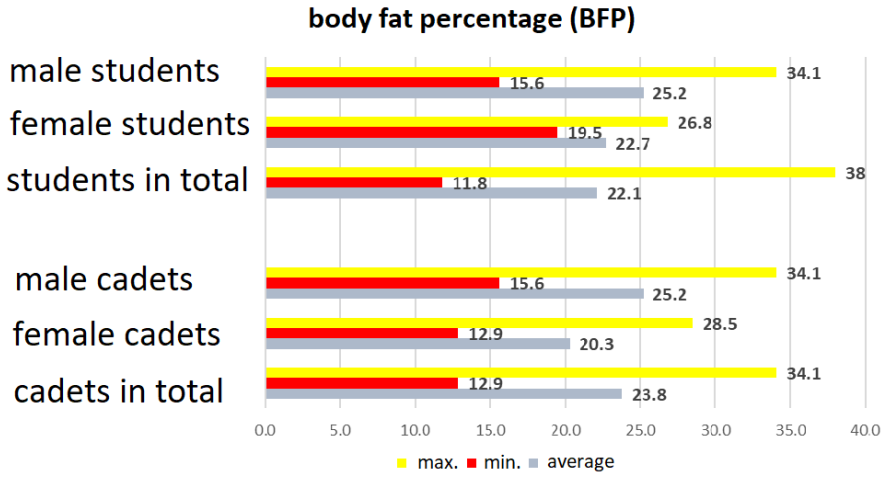


Graph 1. Graphical presentation of the results of a comparative study of two comparable groups of trainees for marine professionals with calculation of body mass index (BMI)

There are also differences between the two groups in the body fat content, which is important for physical performance and refrigeration resistance. For students, the results have larger deviations within the group (11.8-38) and an average of 22.1%. For the cadets the respective values are (12.9-34.1) 23.8%. In both groups there is a slight excess of the norm of the percentage of lipids in the body composition, and this cannot be interpreted in one direction. On the one hand, a small exceedance of the norm would reduce the dynamic characteristics in a situation of assistance or self-help in an aquatic environment. On the other hand, it has a beneficial effect on reducing heat loss and preserving the body's thermal core without significantly burdening the thermoregulation.

The comparison of the obtained values by gender is also significant. The women in the study groups had an average BMI of 21.6 (18.9-24.2) and none was outside the defined norm. Body lipid content is also standard for females 21.3 (12.9-28.5). In men, the average BMI is three points higher 24.5 (19.5-30.2), and the lipid content as an average exceeds the norm 23.9

(11.8-38).



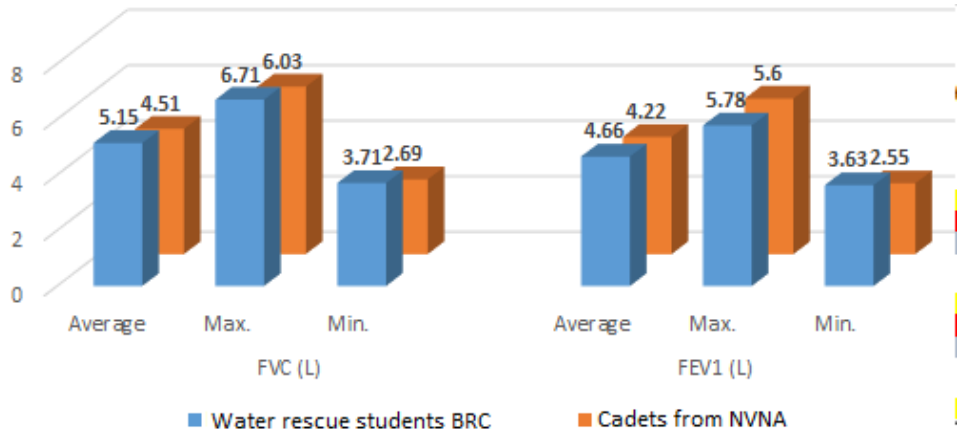
Graph 2. Graphical presentation of the results of a comparative study of two comparable groups of trainees for marine professionals with the calculation of lipid content in body composition.

The relationship between the state of the respiratory system, respectively its functioning and the ability to survive in the marine environment is direct and two-way. This applies in many ways to maritime professionals in situations where assistance must be provided to a victim of a maritime accident. Each of the dozens of parameters reported in spirometry is important for a particular aspect of respiratory function, but for a basic assessment of its condition, three are analyzed: forced expiratory volume for 1 s (FEV1), forced vital capacity (FVC) and their percentage FEV1 / FVC (Tifno index).

From the data of the spirometric study presented in Figure 3 and Table 6. it can be seen that in accordance with the anthropometric indicators, FVC has higher values in the group of lifeguard students than in the group of naval cadets. The measured average value for the cadets from VVMU is 87.6% of that of the water rescuers, and the maximum FVC and the minimum FVC for the cadets are 89.9% and 72.5% of those of the water rescuers, respectively.

Table 6. Spirometric indices - FVC, FEV1 and FEV1 / FVC (%) for water rescue students at the Bulgarian Red Cross and cadets from VVMU.

Study groups	FVC (L)			FEV_1 (L)			FEV_1/FVC (%)		
	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.
Water rescue students BRC	5.15	6.71	3.71	4.66	5.78	3.63	91.23	100.0	75.05
Cadets from NVNA	4.51	6.03	2.69	4.22	5.60	2.55	93.93	100.0	80.10

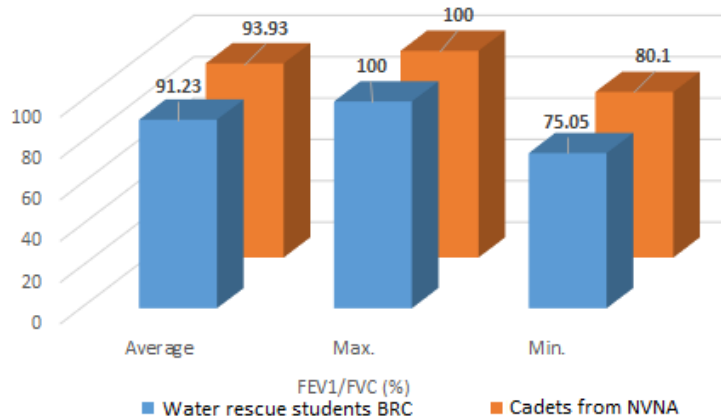


Graph 3. Spirometric indicators - FVC and FEV1 in the group of water rescue students at the Bulgarian Red Cross and the group of cadets from VVMU.

FEV1 also has higher values for lifeguard students than naval cadets (Figure 3 and Table 6). The differences between the two groups, presented in percentages, show that among the cadets from VVMU the average, maximum and minimum value of FEV1 are respectively 90.5%, 96.8% and 70.2% of those of the lifeguards.

Table 7. Spirometric indicators - FVC, FEV1, FEV1 / FVC% in men and women from the group of lifeguards and the group of naval cadets.

Study groups	**Measured values**	**FVC (L)**		**FEV_1 (L)**		**FEV_1/FVC (%)**	
		male	female	male	female	male	female
Water rescue students BRC	Average	5.33	4.13	4.78	3.98	90.26	96.55
	Maximum	6.71	4.83	5.78	4.39	100.0	100.0
	Minimal	4.36	3.71	3.94	3.63	75.05	90.90
Cadets from NVNA	Average	4.66	4.06	4.35	3.78	93.93	93.92
	Maximum	6.03	5.18	5.60	5.07	100.0	100.0
	Minimal	3.10	2.69	2.55	2.66	81.40	80.10



Graph 4. Values of FEV1 / FVC% (Tiffenau index) for water rescue students at the

Bulgarian Red Cross and cadets from VVMU.

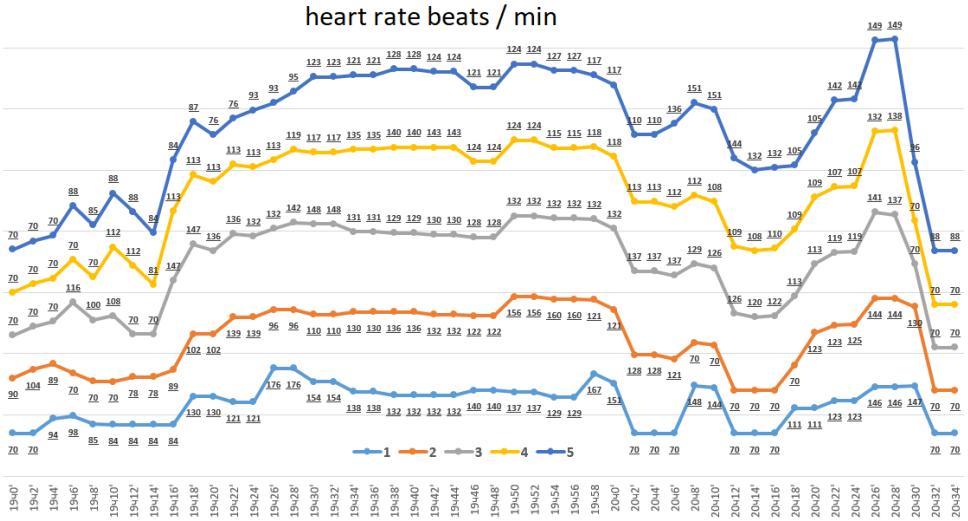
Graph 3 and Table 6 show that the FEV1 / FVC percentage (Tiffenau index) is within normal limits, reaching higher than the reference values (maximum 100%) in the participants from both study groups. However, when comparing the groups, the data show that the values of this indicator are higher in the group of naval cadets. It is known that the Tiffenau index is used for clinical assessment of airway restriction in the airways (Oluseye OO, OO.Ogunseye, 2016). The obtained higher results (calculated on the basis of the measured spirometric indices) in the persons from both groups show on the one hand the very good physical development of all participants in the study, and on the other hand are a prerequisite for high efficiency of lung ventilation and respiratory functions. whole.

When comparing the spirometric indicators according to the sex of the subjects, it is seen that the men from the group of lifeguards have higher values of FVC and FEV1 compared to the men from the group of naval cadets (Table 7). In women, the established trend is maintained - FVC and FEV1 are higher in women lifeguards compared to women cadets from VVMU, but higher maximum values of both indicators were measured in women cadets (Table 7). The maximum FVC and maximum FEV1 in women in the group of lifeguards are 93.2% and 86.4%, respectively, compared to those of female cadets. To the extent that anthropometric data determine the size of the respiratory parameters studied, it is possible that the higher maximum values of FVC and FEV1 in female cadets are the result of greater variations in their growth compared to women in the group of lifeguards.

When comparing the percentage of FEV1 / FVC separately between men and women in the two groups (Table 7.) it is noticeable that in women in the group of lifeguards its values are higher than in female cadets, reaching a maximum of 100% in both groups. For men, the results are better for the cadets from VVMU. The presented data show that in both women and men the Tiffenau index is within normal limits and even exceeds the reference values in most measurements. Higher results of the Tiffenau index in men and women in both groups are a prerequisite for better lung ventilation and at the same time an indicator of better respiratory function.

The data obtained show that all participants had normal spirometric tests. A comparison of lung volumes and capacities between the two groups showed that, according to anthropometric data, FVC and FEV1 were higher in water rescue students than in VVMU cadets (Table 6). This trend is observed in both men and women, but in women the maximum values of FVC and FEV1

were reported in female cadets, probably due to the larger variations in their growth (Table 7). The Tiffenau index is higher in the group of naval cadets (Chart 4 and Table 6), moving in the range of reference values and exceeding them in most measurements. Based on the available data in the literature (Levitzky MG., 2019), the obtained results give us reason to conclude that the measured high values of lung volumes and capacities in the participants of both groups are an indicator of high efficiency of lung ventilation and high functional activity of respiratory system as a whole. It can also be assumed that the high results obtained from the spirometric examination of the participants in both groups are a prerequisite for improving their personal safety when working in the marine environment, as well as for higher efficiency and success of rescue operations.



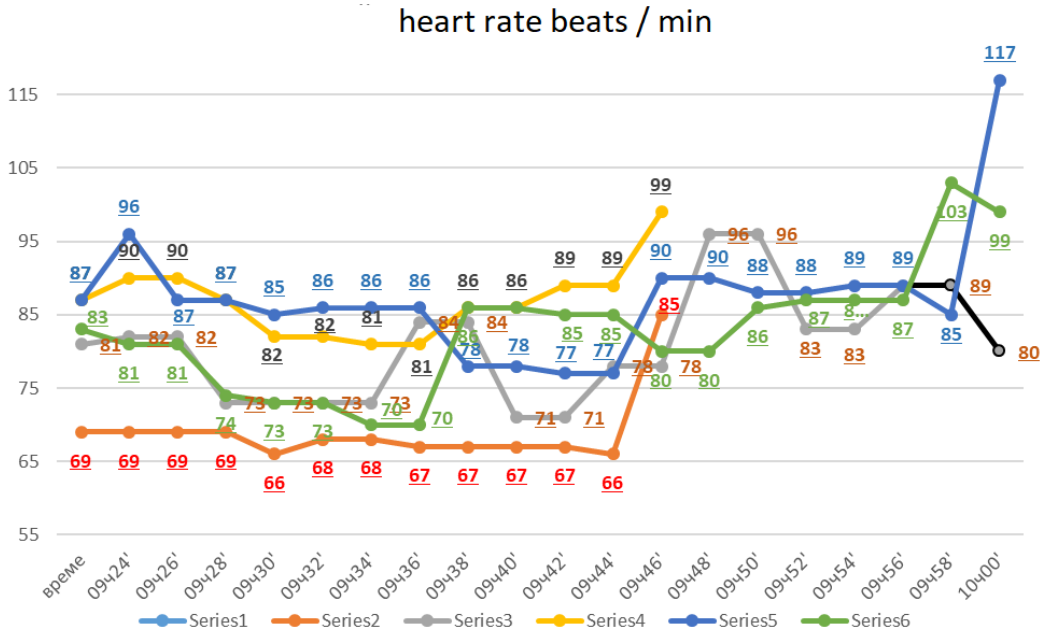
Graph 5. Pulse measurement with waterproof measuring bracelets during training in a training course for lifeguards at sea and in open water areas.

Functional study of cardiovascular function started with the use of waterproof measuring bracelets on 21.07.2020, 07.08.2020, 08.08.2020, 13.08.2020, 18.08.2020, 04.02.2021, 22.02.2021. , 04.03.2021, 21.05.2021, 04.06.2021 Because the marine environment has too many variables, it is difficult to control for comparative analysis. As a beginning of such a study, the practical classes in water rescue of a swimming pool are used and the analysis of the physical activity is carried out on the basis of functionally recorded values of the pulse during the classes with measuring bracelets. During training, the exercises are performed one after the other without leaving time for rest between them. The purpose of the training session is to resemble as much as possible the load during the rescue operation. The sequence of actions is as follows - safe entry into the water from the rescue post; performing a quick approach by swimming to the

drowning person; descent to the underwater part of the accident site; retrieval of the victim (adult drowning manikin or equivalent); transport of the drowning person on land; safe removal of the victim from the water (with the help of other participants in the rescue operation; performing CPR for a period of 10 minutes. Participants do not have time to rest and calm their pulse and breathing. Some of the first results are presented in Figure 5.

Indicative are the results obtained from such a study during the final theoretical examination for acquiring the right to lifeguard for the sea and open water areas. At the end of their training, the subjects are already emotionally and mentally prepared for what lies ahead and have self-confidence.

During the theoretical exam, the results of 5 measuring bracelets show that the best prepared participant is a 34-year-old man with the least deviation from normal heart rate values. Values range from 66 to 85, reaching a maximum of 85 at the last minute alone. Probably due to physical activity and emotional anxiety when handing over the job for evaluation (and leaving the workplace). The other four participants, students, 17 years old, have similar indicators. The values of their surveys range from a low of 71 to a maximum of 117, with three of them reaching a peak when submitting their worksheets, which can be justified in the same way.



Graph 6. Measurement of the heart rate during the theoretical examination for the legal capacity of lifeguards at sea and open water areas.

The real difference between the first volunteer and the other four is the preliminary naval training, the greater life experience and the higher confidence of the first candidate. The other

four are still students and, although physically fit, have less confidence during the theory test.

Another aspect of the use of measuring bracelets is the tracking of the dynamic load of the rescuer during a full working day. Such are placed on practicing lifeguards on the beach of St.St. Constantine and Helena and the central beach of Varna, respectively 25 - 26.08.2020. and 25 - 29.08.20. This requires long-term carrying and reporting of the results of portable measuring devices. Two pilot studies were conducted with long-term (> 24 hours) monitoring of the physiological responses of professional lifeguards during the summer active season of 2020. The participants are a 42-year-old woman practicing on the central Varna beach and a 50-year-old man working on the beach of St. St. Constantine and Helena.

Graph 7. Visualization of some of the measurements during prolonged wearing of a measuring bracelet (> 48 hours) during the exercise of the profession of lifeguard on the beach.

The subjects were of both sexes and of different ages in view of the differences in the average oxygen uptake in women and men (35 and 44 ml./kg./min. Respectively) and the decrease of this value with increasing age (by approximately 7%). every 10 years). The first results are available. The bracelets used in our experiment allow the results to be properly stored in the device itself for 14 days and to monitor the variability of the heart rate, which is used to calculate the level of stress. The intense minutes for the day, for the week, the total calories burned for the day, including those during rest and activity are taken into account. The obtained data can be collected, compared and tracked in professional, local, regional, national and international databases. In this way, on the one hand, the health and functional condition of individual marine professionals is monitored, on the other hand, the dynamics, comparisons between the different categories allow for scientific and practical analysis and development of algorithms and standards to increase safety at sea.

Physical capacity and mental resilience are the basis on which the professional skills of

marine professionals are built. The high performance of these complex characteristics is important in extreme sea conditions, especially in hazardous situations where the protection of human life may depend on them. In 2020, a study will be launched on the personal characteristics of trainees for lifeguards and the changes that occur after the training. To achieve this goal, research is conducted at the beginning and end of the course. Psychological questionnaires were used to determine the level of resilience to stress and personal characteristics: anxiety, frustration, aggression and rigidity. The obtained results are compared with a comparable group of trainees for marine professionals (cadets). The study focuses on the existing correlation between the level of resilience to stress and the level of rigidity of learners.

The profession of lifeguards is characterized by increased demands on the personality of the future lifeguard. She is extremely responsible and requires the development of certain professional qualities in lifeguards. They can be divided into subgroups - qualities that relate to the performance of tasks (operational area of the professional), professional abilities, consciousness, thinking, etc. It is important to note that significant qualities develop in the process of specialized training and activities (Avanesov B. C., 1982, Aspednikov, MG, 2020). In the process of training knowledge and skills are acquired, the formation of certain professional habits begins (definition of "habit" - automated, sustainable, simple or complex form of action or activity that contributes to increasing the achievements and accuracy of performance), which are at the heart of the work of future lifeguards. The peculiarities of the lifeguard profession are determined by the specific working conditions, the direct influence of the atmospheric conditions, the collision with extreme (critical) situations, the maintenance of a high level of situational vigilance. The profession requires the development of the ability to assess possible risks and options for action in different situations. Extreme situations manifest themselves in four ways: stress, frustration, conflict and crisis (Bodrov VA, 2001). Stress occurs under the influence of some (most often extreme) factor, which causes a change in mental and physical activity. Frustration is a state of tension that arises in a person in conditions of strong motivation to reach the goal and the presence of a barrier (objective or subjective) that prevents the achievement of the goal. Conflict is a state of mental tension arising as a result of a collision of persons with different motives or in the presence of an internal conflict between two opposing motives. Crisis is a state of mental tension, which is characterized by the inability to resolve the extreme situation of the individual and requires complete mental restructuring and acceptance of new values and motives.

The various extreme situations are completely real and can occur at any time during the rescuer's work. It is especially important for rescuers to be able to react adequately in any situation by making quick decisions in it, regardless of its manifestation and nature.

Therefore, in order for the rescuer to successfully cope with the high workload, it is necessary to develop professionally significant personal qualities such as high stress resistance, high frustration threshold, self-control, self-control in resolving conflict situations and others. The purpose of the present study is to trace the personal qualities of learners for lifeguards and to determine the level of their development in the learning process. To achieve this goal, a survey was conducted with rescuer trainees at the beginning and end of their training. The object of research are the students (25 students), training for lifeguards in the General Assembly of the Bulgarian Red Cross-Varna. The survey is anonymous and conducted with the written consent of the participants. Questionnaire placed at the beginning of the survey and requires the completion of demographic data.

The tasks of the study are two:

1) determination of professionally significant personal qualities;

2) determining the level of development of the personal qualities of the rescuers during their training.

With the accumulation of the required number of subjects - students training for lifeguards at sea, swimming pool and open water areas, the results provide the opportunity to be compared with subjects - cadets at VVMU. Another aspect is comparing the results with those of existing rescuers. This allows a more detailed study of the profile of marine professionals.

Survey procedure: In order to achieve the objectives of the survey, the participants in a lifeguard course fill in self-assessment questionnaires at the beginning and end of the course. Methods used:

1) Questionnaire part - requires participants to indicate gender, age, profession and sports activity.

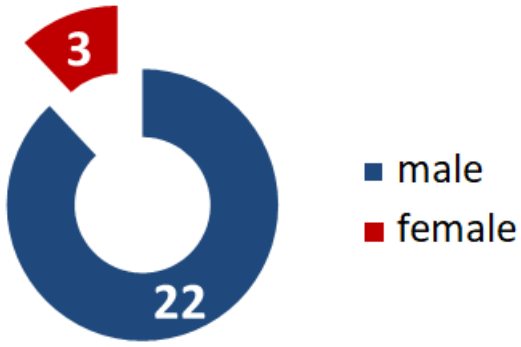
2) Test for self-assessment of mental states of H. Eisenk (Batarshev AV, 2000). This questionnaire examines the following mental states:

3) Questionnaire for studying the resilience of stress of V. Rusinova and S. Zhilova.

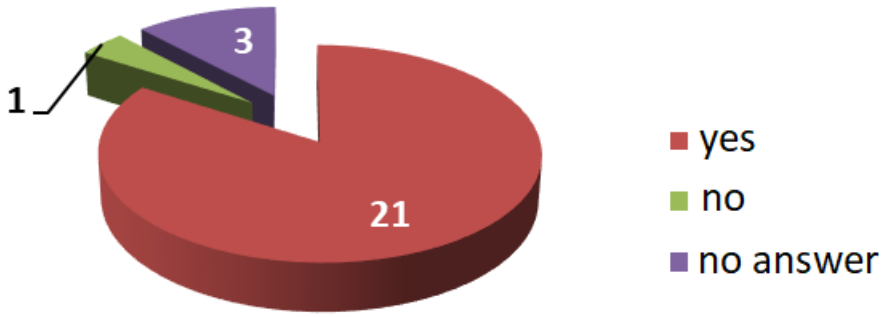
The questionnaire measures the degree of resilience of a person to stress. The statements focus on ways to deal with stress and respond to stress. The results show that most of those willing to train as lifeguards are men. Cultural stereotype puts men in the role of saviors. This is

the attitude that the society supports and it corresponds to the individual attitudes of the participants, giving a possible explanation why over 80% of the surveyed persons are men. Those who practice high-risk occupations are mainly males, whose physique helps to cope with higher workloads. Of the 25 respondents, only 3 respondents were female. This can be explained by the great physical exertion, as well as by the formed notions related to the image of the savior - a man. Graph 8 presents the distribution of the surveyed by gender.

Due to the high physical activity and existing coping resources, the participants were assigned to answer questions related to sports. The question "Do you play sports?" is interpreted ambiguously by the respondents. The first question is "Do you play sports?" - out of 25 respondents, 21 answered positively, only one indicated a negative answer. Some of the respondents define sports as participation in organized sports activities, clubs or perceive their periodic physical activity for health or entertainment as street fitness, running as a sport. It is possible that the respondents who did not indicate an answer perceive sports activities as a hobby or entertainment, and not as a sport. As can be seen in Figure 9. - the presented results of the question "Do you play sports?" there are 3 respondents who did not indicate an answer. To the next question "What kind of sport do you do?", Again there are three respondents who did not indicate an answer, which may be due to reluctance to answer the question.

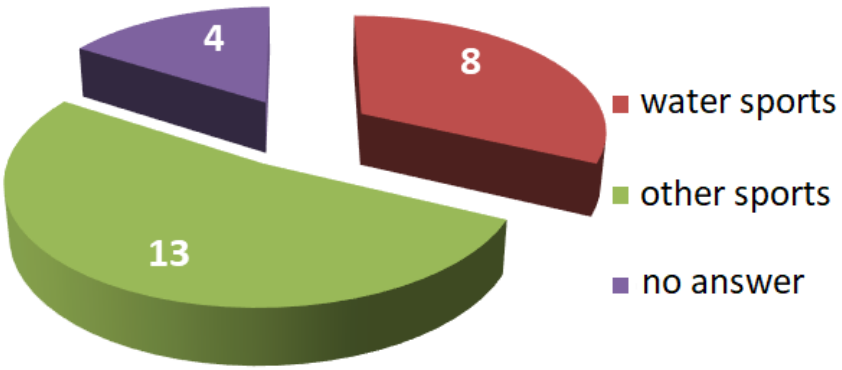


Graph 8. Distribution of the subjects by sex

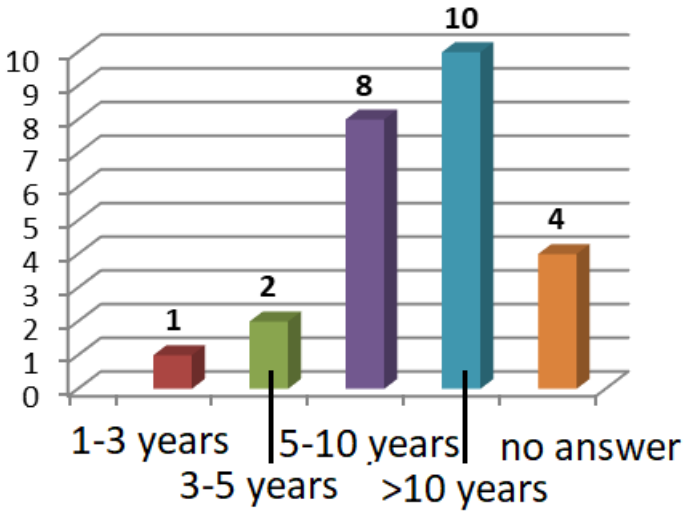


Graph 9. Distribution of the results of question № 2 “Do you play sports?”

When asked what kind of sport students practice, they can indicate water sports or other sports. Graph 10 presents the distribution of the received answers. The results show that the majority of students play sports, but the sport is not related to maritime disciplines. The moment with specifying the duration of sports activity is especially important. The formation of motor habits, their maintenance and development is important for the implementation of future professional activity. The answers to this question are divided into years. The results presented in Chart 11. show that nearly 50% of respondents indicate that they maintain sports activity for more than 10 years. The obtained data give grounds to assume that the profession of rescuer is directed to persons accustomed to physical exertion, developed a certain degree of physical endurance, able to set and maintain the pursuit of a certain regime and goal.



Graph 10. Results of the question "What sport do you do?"



Graph 11. Distribution of the results of the question "How long have you been playing sports?"

Due to the small sample size, the obtained data can be used to present a preliminary profile of the personality of the future lifeguard. The summarized data for the sample are presented in Table 8. The interpretation of the data is according to the average indicators in the median. The personality of the future rescuer, outlined so far, is a man, aged 18 - 20 years, a pupil or student who maintains sports activity on average from 5 to 10 years. It is interesting to trace the relationship of these characteristics to personal qualities. All students demonstrate low levels of anxiety and a high frustration threshold. Indicators of both mental states aggression and rigidity are normal. The subjects show good stress resistance.

Resistance to stress is the most important quality of the rescuer's personality, key to dealing with the requirements of this highly responsible profession. From the analyzes performed with a non-parametric method for testing hypotheses with Crosstabs, no relationship between gender and personality resilience was observed. There was a statistically significant positive significant correlation (rs = 0.516) between rigidity and the level of stress resilience measured at the beginning of the rescuer training course, which shows that students who are characterized by a higher level of stress resilience in -significantly show rigidity. This further gives grounds to continue the research in this direction to determine the relationship between the two characteristics. In focus groups with the surveyed students, it was clarified that the statements related to the measurement of the level of rigidity are perceived as following a system of rules and their observance. From this point of view, it can be assumed that in this case rigidity as a personal characteristic is loaded with a positive meaning. The requirements of the profession to

the personality of the rescuer are based to a large extent on the performance of specific actions in a specific sequence, which corresponds to the participants' understanding of rigidity.

Table 8. Results of the study conducted with students training for lifeguards at sea and open water areas.

	Anxiety	Frustration	Aggression	Rigidity	Resistance to stress at the beginning of the course
Average	6,12	3,96	8,72	8,96	56,5600
Median	6,00	3,00	8,00	9,00	56,0000
Fashion	4	2[a]	9	11	56,00
Standard deviation	2,666	3,372	4,306	4,178	4,84837
Asymmetry	,434	1,476	,246	-,096	-,091
Excess	-,597	3,458	,039	-,391	,088
Minimally	2	0	0	1	46,00
Maximum	11	15	18	16	66,00

A statistically significant negative moderate correlation rs = - 0.403 was found between exercise and the level of frustration. The subjects who exercise also show a higher frustration threshold, ie. accept the obstacles on the way to the set goal and react adequately to the situation. These initial data are of interest and can be definitively confirmed when a larger database is accumulated. The impact of sport on the individual, and in particular on his or her resilience, has been the subject of much research and should be further explored in lifeguard trainees. Of interest is the study of the impact of the training process on the personality of the rescuer, which will be established after completing the optimal number of examinations. The presented results also show a significant positive moderate correlation rs = 0.488 between the sport and the duration of its exercise. Respondents who train for a longer period of time are those who practice other non-marine sports. It can be assumed that ground sports such as football, volleyball, basketball and others. are more accessible and predispose to longer practice.

The results show a positive significant significant correlation rs = 0.695 between the stress level measured at the beginning of the lifeguard course and the stress level measured at the end of the course. This gives reason to assume that the knowledge acquired during the course and increased physical activity leads to an increase in the level of stress resistance.

The obtained results give grounds to present the following conclusions:

1. The practice of sports for a long period of time can be defined as a "filter" for choosing a

profession. On the one hand, good physical condition allows easy achievement of the results of the required standards, and on the other hand, the educational role of sports increases mental confidence and self-confidence in engaging in such a responsible activity as rescue. Sport is a determining factor in choosing a lifeguard profession, as well as influencing the level of frustration.

2. During their training in the specialized courses at the Bulgarian Red Cross these qualities are strengthened, especially their psychological dimensions.

3. The physical parameters relevant to the rescue operation cannot undergo a significant change in the training for two reasons. First, the relatively short duration of the courses - about a month does not imply significant quantitative changes in the basic functions of the musculoskeletal system, respiratory and cardiovascular systems. Second, for such training are enrolled mainly persons with well-trained and developed functional systems.

4. The good preliminary attitude and motivation allow effective mastering of the methodologies and stimulate the personal characteristics related to the rescue activity. The level of stress resilience measured at the beginning of the course is influenced by the level of rigidity, which allows learners to absorb the structured material well and to master rescue techniques in the required order.

The study is the basis for a more extensive and comprehensive study tracking the impact of various factors on the profile of the future savior. The questionnaire part is subject to expansion and enrichment in its part related to the exercise of sports activities. Expands the scope of research to include lifeguards, cadets and other marine professionals. Such an approach allows comparing the results of comparable groups.

When organizing the experimental voyage with a reed ship 25. III. - 2.IX. In 2019, a model was created for reporting some physiological and psychological parameters directly related to the health status of the participants. The Bulgarian participant in the project was involved as a volunteer. It is planned to perform medical examinations before and after the expedition and to take into account anthropometric and physiological indicators. Blood pressure, heart rate, body temperature and psycho-emotional parameters should be taken into account during the experimental voyage from Varna to the island of Crete. For this purpose, reliable automatic measuring devices have been prepared, which do not require their handling to be performed by a medical professional.

Portable and waterproof electronic devices are provided for measuring blood pressure and

body temperature. They are charged with batteries, tested and calibrated. Research is trained and instructed to work with the equipment and to archive the reported results.

To monitor heart function, the ECG monitor provided consists of small electrodes placed with adhesive to the chest of the test in versions with wires or wirelessly connected to a small recorder attached to a belt. The subject receives a diary in which to record his own observations and feelings oriented in time. In this case, the following categories of outpatient ECG monitors are subject to choice:

Continuous monitors that store the electrical signals of the heart for the entire duration of a long period, which can record 48 or more hours with the possibility of continuous operation for a week. Technology allows outpatient ECG monitors to have more memory while still being small and light; they are known as Holter memory efficient monitors and patch monitors (designed without wires connecting electrodes to the recorder).

Interrupt long-term monitors (Event Monitors) store electrical signals from the heart only when the monitor is triggered by an abnormal heart rhythm.

Real-time cardiac telemetry systems, also known as mobile cardiac outpatient telemetry - similar to long-term continuous monitors, but can send data directly to a central monitoring station instead of recording for later retrieval.

More than one hundred brands of Holter short-term and long-term monitors and four brands of external recorders have been identified.

A questionnaire for the psychostatus was prepared in cooperation with a psychologist professionally engaged in the training of marine professionals. It was provided to the participant in the expedition by reed ship.

Marine medical examinations during the Abora experiment are not performed for reasons that arose outside of those working on the intended scientific program. After the end of the experiment, the Bulgarian participant provided detailed information about its course. It derives important aspects related to health, physical and psychological stress. It derives important aspects related to health, physical and psychological stress, health and safety risks in this type of marine experiment. Some of them are:

- Experimental seafarers are not professional sailors, athletes or others with marine experience. They have a week before departure to get to know each other.

"The heavy weight of the ship's sail." The load is extreme during its lifting, and in the raised position it is required to always have a person who stretches the ropes. It is changed every

15 minutes. After each shift the participant experiences pain in the whole body.

- The reed ship turns out to be quite stable and no one gets seasick.

- The crew is experiencing high climatic loads. It is very warm during the day and very cold in the evenings.

- The watch service is quite impressive. The shifts are 6 hours, instead of the better option 4 hours.

- No medical examination is required before departure. The only thing the Bulgarian participant has is a vaccination certificate.

- Personal hygiene is also a problem. Brush your teeth with drinking water, bathe in the sea, and go to the toilet at the back of the boat.

- There are medical problems related to food. Several people complain of the disorder. According to the Bulgarian participant, it is from the food stored in the heat. This is the only declared medical problem.

- The fact that the sailors were from different nations leads to interpersonal problems. Opposition even leads to physical self-mutilation.

- As part of the study, a questionnaire was prepared and used to assess the psycho-emotional aspects of experimental seafaring. An important aspect of the expedition is tracking the course of psychological processes at the individual level. In the beginning, in connection with the responsibilities for organizing the construction of the ship, symptoms of increased stress begin to appear - anxiety, irritability. The family is a major source of support and supports the stress control process. Building friendly relationships with individual other participants has a beneficial effect. Friendly support has a buffering effect in stress control, helping to cope. Perseverance, ambition, dedication to the goal (idea) are some of the qualities that are characteristic of a person with a high level of resilience (resilience). During the expedition the participant relies only on his own strength. The opportunities for solitude, although minimal, compensate to some extent for the lack of cohesion of the crew and the sense of support, which is especially important in conducting voyages. Resilience develops precisely in the encounter with difficulties and overcoming them. Expanding the experience helps the person, enriching his life repertoire. After returning, thanks to relatives and friends, the adaptation to normal daily life takes place within a month.

- The conclusions of the experiment can be considered in two directions: personal and organizational.

- Personally, participation in such an endeavor requires maintaining a high level of motivation, resilience and striving to achieve the goal, which is extremely difficult. Facing personal problems - separation from the family (during the construction of the ship and sailing with it), lack of empathy on the part of the management in the service, changing requirements for participants during the expedition lead the person to test their own capabilities.

- Successful overcoming of all difficulties, as well as fast recovery are an indicator of high personal resilience. The experience gained in organizing the expedition expands the life repertoire and forms clear and specific ideas in the participant in the expedition about the necessary means and opportunities for organizing such an expedition, relating to the documentary part and interpersonal relationships.

- Trust, faith in the "honest word" in the relationship must be supported by purely administrative procedures - signing and stamping documented agreements between their partners.

- The mixing of the two roles - scientific leader of the expedition and captain of the voyage is not always functional.

- The preparation for work at sea, training for team work, as well as the management of a multinational crew, which is passed by the captains of ships, contribute to the successful completion of the set tasks, which also applies to experimental voyages.

- Lessons from practice prove once again the need and importance of the training that marine specialists undergo for the successful completion of the voyage. An integral part of this success is the prevention of health accidents and the good preparedness to react to such accidents.

In the implementation of activities under the third task the following results and summaries were reached:

1. A model has been created for studying the effect of living in an aquatic environment under normal and extreme loads. It includes new approaches and research that have not been done so far.

2. The studies must be carried out using appropriate methods and apparatus. Such have been identified and delivered.

3. The parameters of the physiological manifestations of the respiratory, cardiovascular systems and musculoskeletal system shall be taken into account for the assessment of the impact of the marine aquatic environment. The obtained results are archived, analyzed, entered in tables

and presented graphically.

4. No less important are the psychological processes at the individual level and group level of potential victims and rescuers in a maritime accident with water injuries. Statistically significant were found: a positive significant correlation (rs = 0.516) between the rigidity and the level of stress resistance measured at the beginning of the rescuer training course; negative moderate correlation rs = - 0.403 between exercise and the level of frustration; positive significant significant correlation rs = 0.695 between the stress level measured at the beginning of the lifeguard course and the stress level measured at the end of the course.

5. The dynamics of the processes requires the model of marine medical research to be constantly adjusted and improved.

6. The system for upgrading the research approaches and expanding the scope of the research increases the level of objectivity of the results. This in turn allows higher predictability and optimization of the safety systems in the training and activity of marine professionals.

3.4. Study of the readiness of the population to provide assistance in case of water injuries. Identification of measures to increase the competence of the population to act in case of maritime accidents and catastrophes.

It is much more likely for marine professionals than for anyone else to be in a situation to assist an accident victim. With their good preparation, in many cases they manage to provide timely and adequate assistance. On the other hand, incidents occurring at random unguarded places at sea and along the coast are much more likely. Then it is necessary to help those affected by the people present and to rely on their common culture in this regard. In view of the specifics of medical care for water injuries, it is extremely important to assess the level of preparation of citizens who, for domestic, professional or other reasons, find themselves at the scene of a water accident. This is the purpose of a survey on the possibilities and attitudes in society to provide assistance in case of marine water incidents.

In 2019, a large-scale study of the skills and readiness for first aid after the population with a special focus on water injuries was conducted. The study included people from different social categories and groups, with a focus on young people with an active life position and social status. In the survey were analyzed analyzed specific data from citizens of different categories from the city of Varna, from the other large sea city of Burgas, from large cities far from the sea and those from small villages far from the sea. Mostly young and active people were interviewed. This is due on the one hand to the pronounced vital activity of such people and the relatively higher probability of living in a marine environment and getting into an accident related to it. On the other hand, such socially active individuals are more likely to participate in the rescue and assistance of those affected by a water accident.

The questions are formulated and arranged as follows:

1. Can you swim?
2. Can you help a person in a water accident - get him out of the water?
3. Do you know first aid methods?
4. Do you know the specifics of first aid for drowning?

The following are two clarifying questions with a positive answer to the third question with 5 and 6 possible answers, respectively. In the case of clarifying questions, the respondent may indicate several answers.

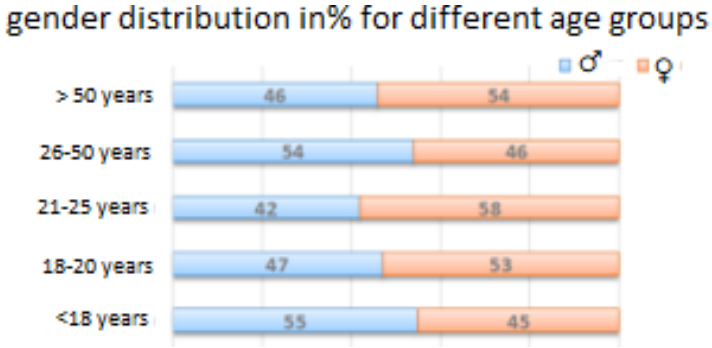
Table 9. Distribution of the respondents in the survey. The students of the Military Doctor field

are represented in the two sections - of MU - VVMU, due to the fact that they are students in both educational institutions.

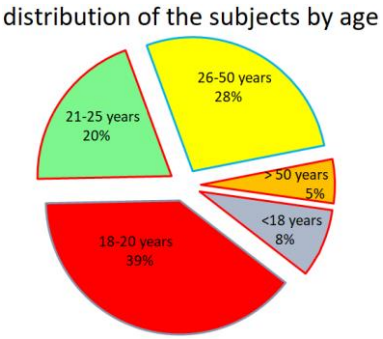
Category			number
Students Varna (scholar)			**56**
Military	Divers	14	**32**
	Servicemen	18	
Cadets at NVMA - Varna	Cadets	40	**102**
	Military doctor	37	
	Students	25	
Active age	Students BRC	108	**183**
	Volunteers Blood donors	22	
	Border police	53	
Students at the Medical University of Varna	Medical	132	**259**
	Military doctor	37	
	Obstetrics	36	
	Nurse	37	
	professional center	17	
Students from other universities			**205**
Students in water rescue courses at the Bulgarian Red Cross-Varna			**110**
Retirees			**32**

The form with the questionnaire, which was provided to the participants on paper. A WEB-based questionnaire from the Google Forms application was attached to some of the respondents in the cities of Varna and Ruse.

942 people participated in the survey on a voluntary basis, completely anonymously. The gender distribution is 457 Men 49% and 485 Women (51%). The average age of the participants was 27 years, and the distribution by age is visible in Chart 13.



Graph 12. Distribution of the respondents by gender in the different age groups.



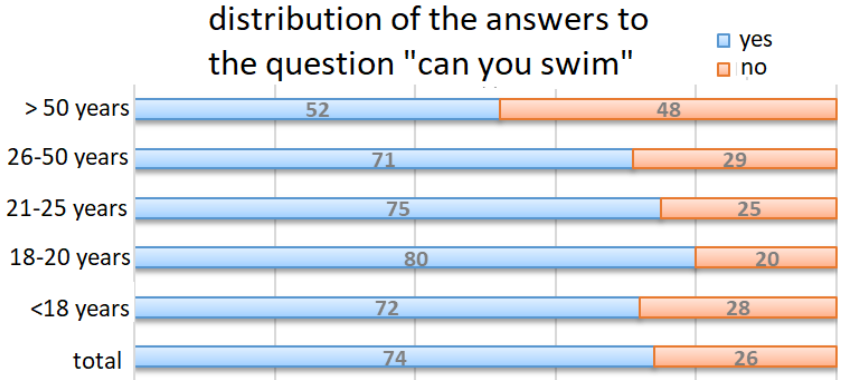
Graph 13. Graphical presentation of the distribution of respondents by age.

Results analysis.

The distribution of the surveyed by gender M / F has a slight predominance of females 51% / 49%. It corresponds to this distribution nationally (https://www.nsi.bg/bg/content/2977) and worldwide.

Age comparison:

Almost ¾ (74%) of the respondents have (or have the self-confidence to have) swimming skills. This value should not be mechanically transferred to the entire Bulgarian population, due to the fact that the study focuses primarily on the active population. Children at an early age are not included, and from the pensioners in the study mainly socially active ones participate. However, the high percentage is a good indicator, because it is the people from these social groups who are likely to help in an accident of water trauma. As far as the possession of swimming equipment guarantees personal safety in the aquatic environment, the remaining 26% of the respondents could not be expected to provide assistance in case of a maritime accident. However, in cases where they are present in a situation where the victim is removed from the hazardous aquatic environment, the skills of first aid and especially the specifics of medical care in case of drowning are extremely important.

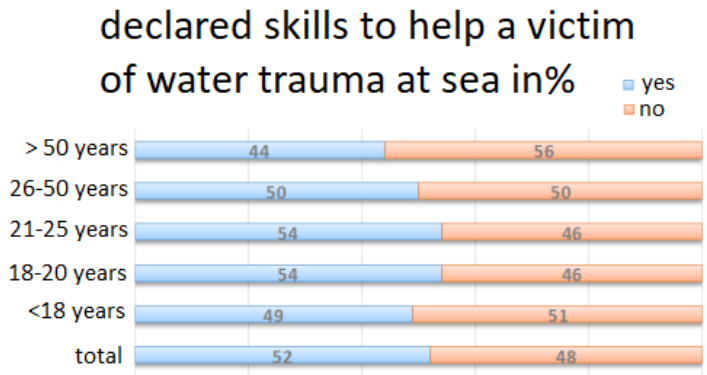


Graph 14. Graphical presentation of the declared swimming skills in the different age

groups.

Out of a total of 241 people unable to swim, 134 or 56% know first aid methods. Nearly half of the respondents in this group can apply artificial respiration 52% and cardiac massage 48%. For the methods included in the questionnaire ⅓ of these respondents declared possession of primary wound treatment, respectively 39%, cessation of external bleeding 32% and immobilization in case of bone fracture 27%. Only 33% of the same group know the specifics of first aid for drowning. Most of them 37% have received training for action in a critical situation in courses of the Bulgarian Red Cross and only 21% in schools.

461 or 52% of the respondents declare their ability to help a victim in case of an accident at sea or in the aquatic environment. This is the non-medical part for overcoming the damage from water trauma in accidents, accidents or catastrophes at sea. It is about skills to bring the victim out of the risky aquatic environment. Of this group, 282 or 58% know the specifics of first aid for drowning. The age analysis shows that the percentage is below 50% in only two categories - under the age of 18 and those over 50 years. For the former, this figure is not particularly worrying, on the one hand, given that they are just entering public life and preparing for it, and on the other hand, that they have been released from liability due to a minor.

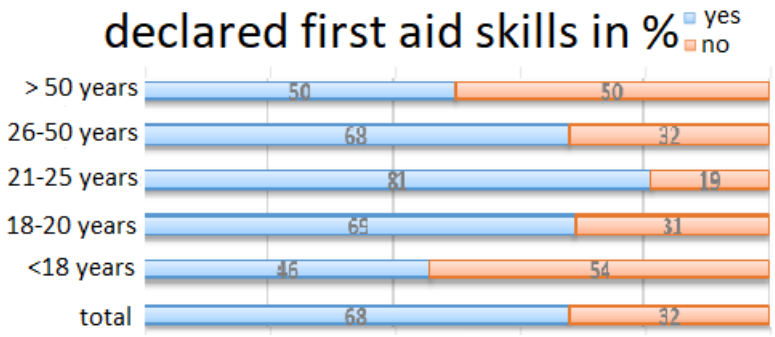


Graph 15. Graphical presentation of the declared skills to help a victim of water trauma at sea. This is the non-medical part (removal from the aquatic environment) in case of an accident at sea.

In people of pre-retirement and retirement age, the time for mastering such skills is practically running out and combined with the declining physiological abilities the prospect is not favorable. This combined with the demographic crisis in Bulgaria, which determines the aging of the population is not a good indicator. The attempt to train people of retirement age was made in 2015 under the project "Raising awareness of older people to respond to disasters, accidents, disasters and first aid" and achieved some results in improving this training among the

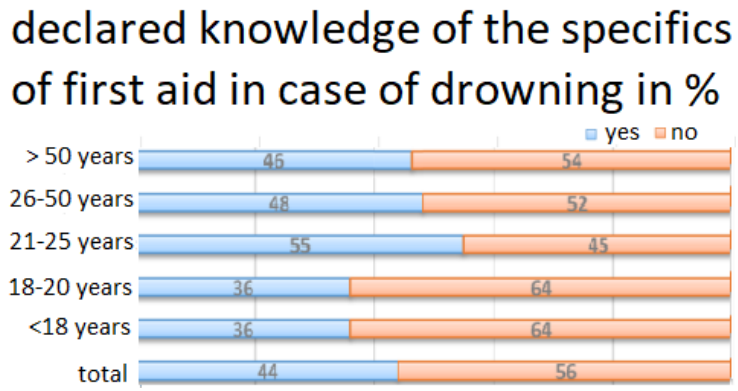
most vulnerable group of pensioners from the Asparuhovo district of Varna.

The declared answers to the third question of the survey "Do you know first aid methods?" Are distributed in the ratio 644/298 (68% / 32%) YES / NO or ⅔ are able to provide first aid. The highest percentage is represented by the respondents from young active age from 21 to 25 years - 81%, followed by those 18-20 years - 69% and 26-49 years 68%. The most unprepared for first aid are the oldest over 50 years of age - 50%. Most of the respondents - 46% have received such training courses at the Bulgarian Red Cross.



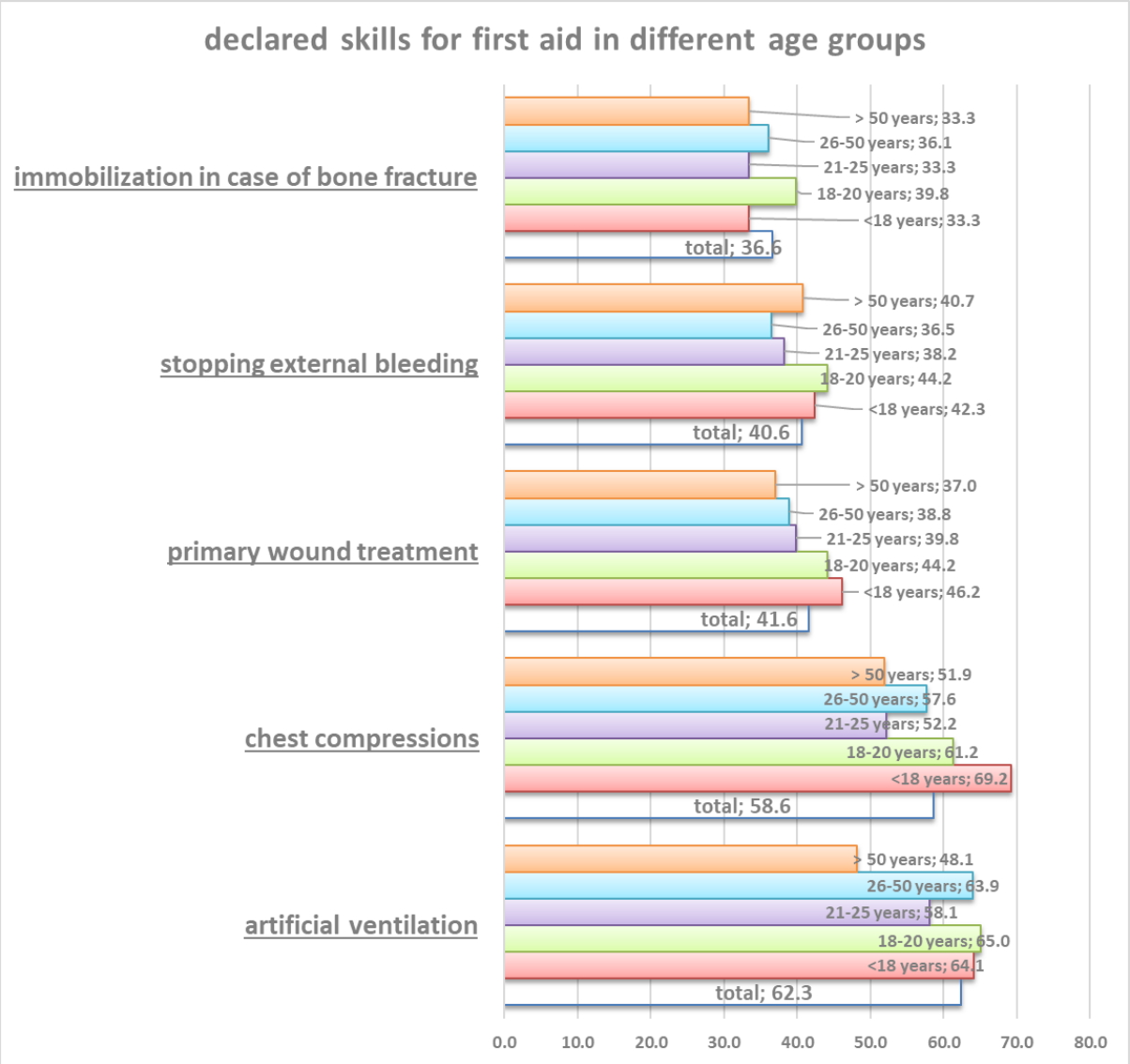
Graph 16. Graphical presentation of the declared first aid skills in the general sense.

The provision of medical care in case of drowning has its own specifics, which is important for the prospect of survival of the victim in a water accident. With this indicator, the total share of those in power (or those who have the confidence to know) the characteristics of the DAC is less than half of those surveyed (44%).

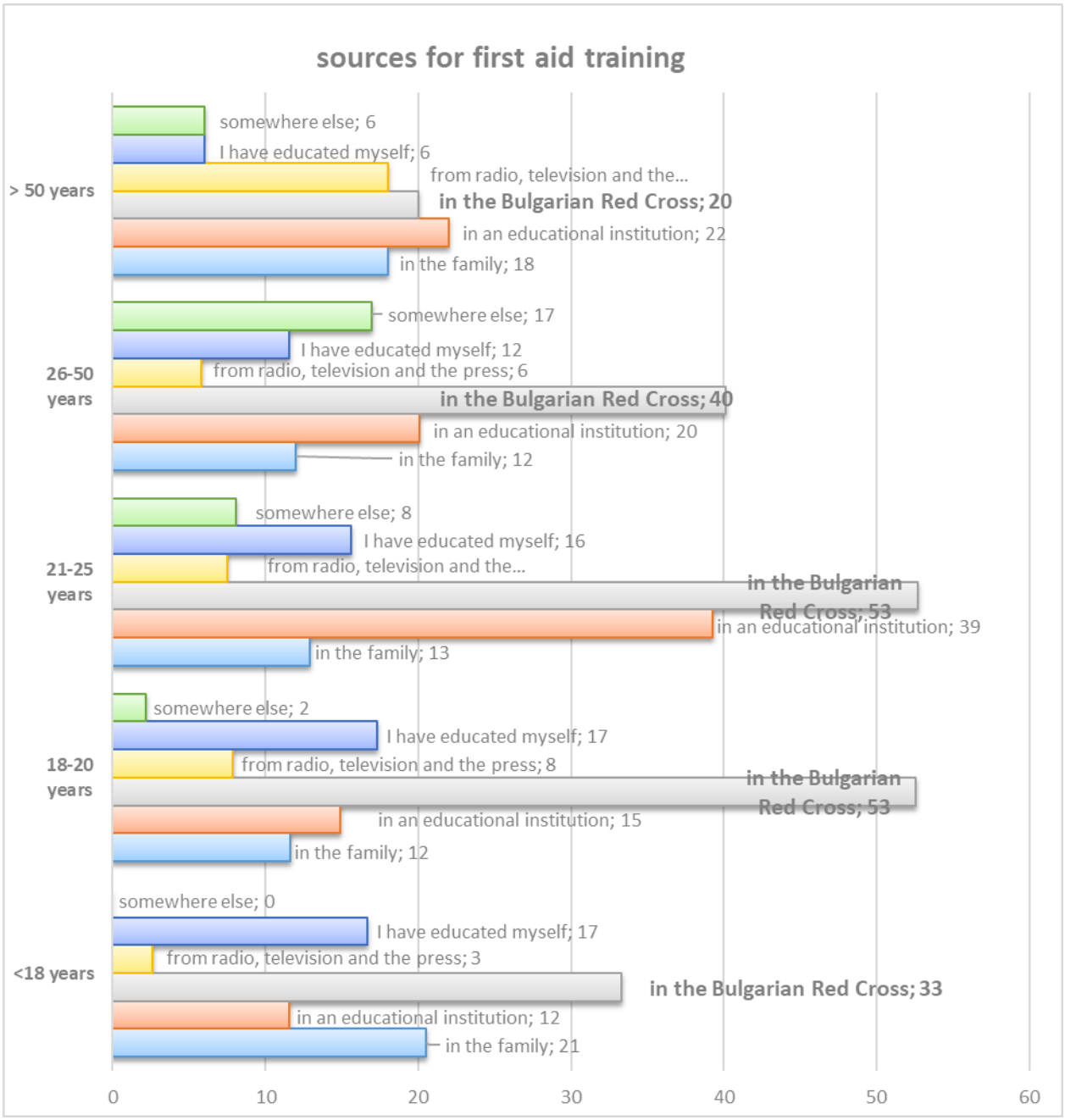


Graph 17. Graphical presentation of the declared knowledge of the specifics of first aid in case of drowning.

In the age range from 21 to 50 years, the ruling / non-ruling ratio is reversed. This result commits attention to directing more resources to explain and educate the population and especially those living and living along the coast. Comparison by place of residence (regional sign)

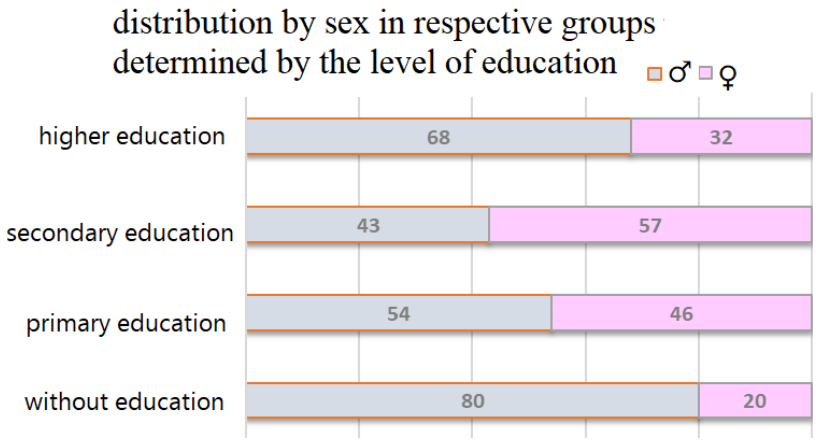


Graph 18. Graphical presentation of the declared skills for first aid in different age groups.

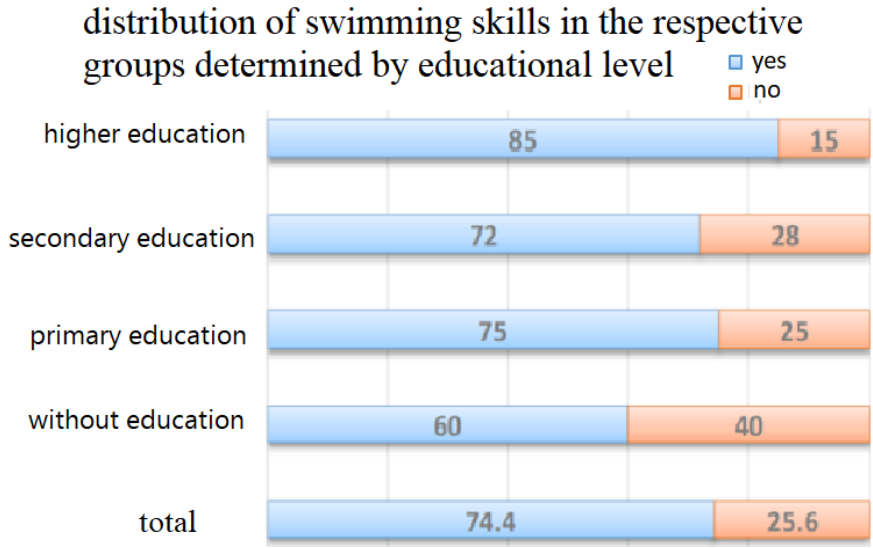


Graph 19. Graphical presentation of the sources for first aid training declared by the respondents of different ages.

Comparison of the results distributed by indicator educational level.

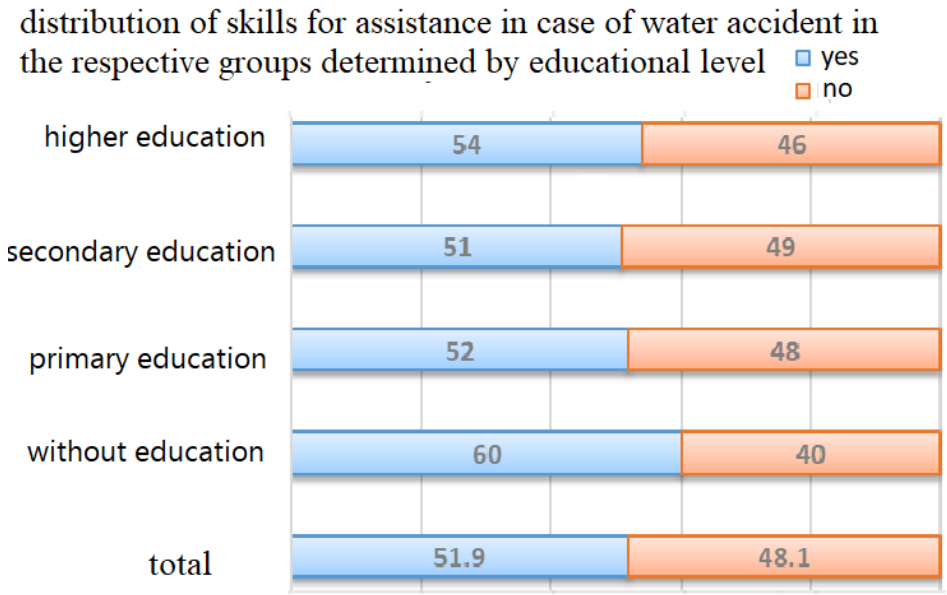


Graph 20. Graphical representation of the distribution by sex in respective groups determined by the level of education.



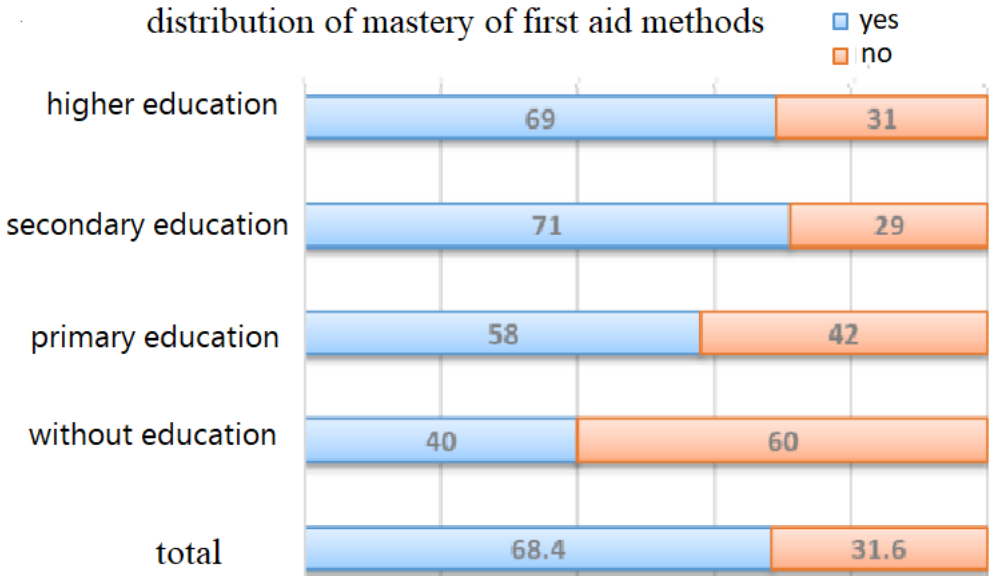
Graph 21. Graphical representation of the distribution of swimming skills in the respective groups determined by educational level.

Swimming skills in the active part of the population are at a high level - ¾. This is a good indicator that corresponds to the lasting trend of reducing mortality from water injuries in Bulgaria. The highest percentage of swimmers is given by people with higher education - 85%, and the lowest by those without completed education. The second is not particularly worrying due to the fact that it concerns students, as part of the general group of respondents who have years ahead of them to master this aspect of marine motor culture.



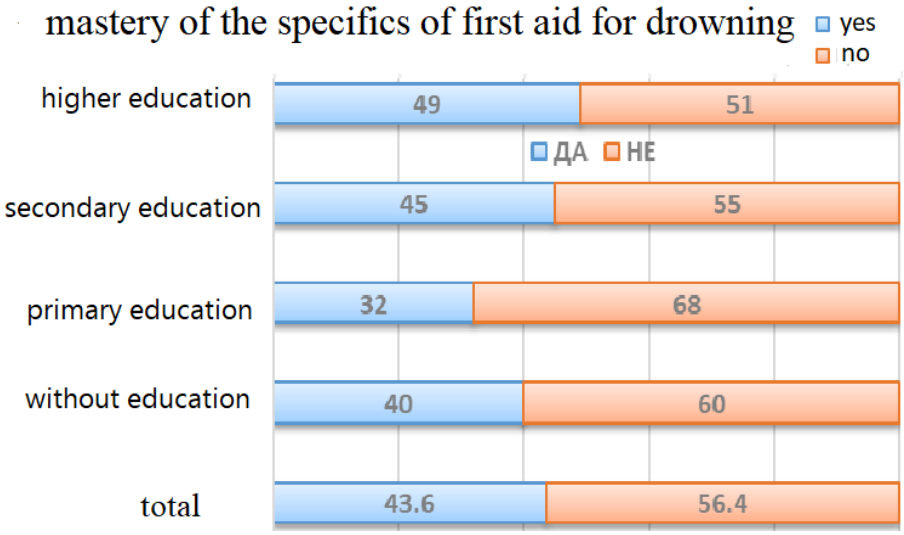
Graph 22. Graphical representation of the distribution of skills for assistance in case of water accident in the respective groups determined by educational level.

The ability to get out of the water environment in a timely manner in case of a maritime accident is a determining factor for saving the lives and the degree of injuries of the victims. Only half of the respondents have these specific skills, and there are no significant differences between the different groups. These specific knowledge and skills objectively do not correspond to education in its various levels. They are acquired in the most general case of specialized courses in the BRC system.



Graph 23. Graphical presentation of the distribution of mastery of first aid methods in the respective groups determined by educational level.

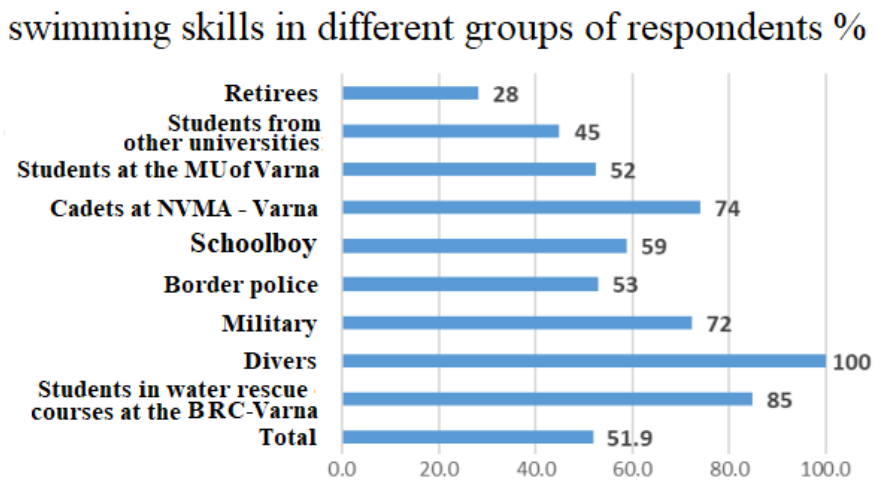
Regarding the mastery of the methods of first aid лица by the respondents with secondary and higher education they have confidence that they know such methods. In those with primary education a little more than half have such knowledge and skills, and in those without completed education only ⅖ of the respondents. The analysis shows a direct dependence on educational qualifications and mastery of first aid skills.



Graph 24. Graphic representation of the mastery of the specifics of first aid for drowning in the relevant groups determined by the level of education.

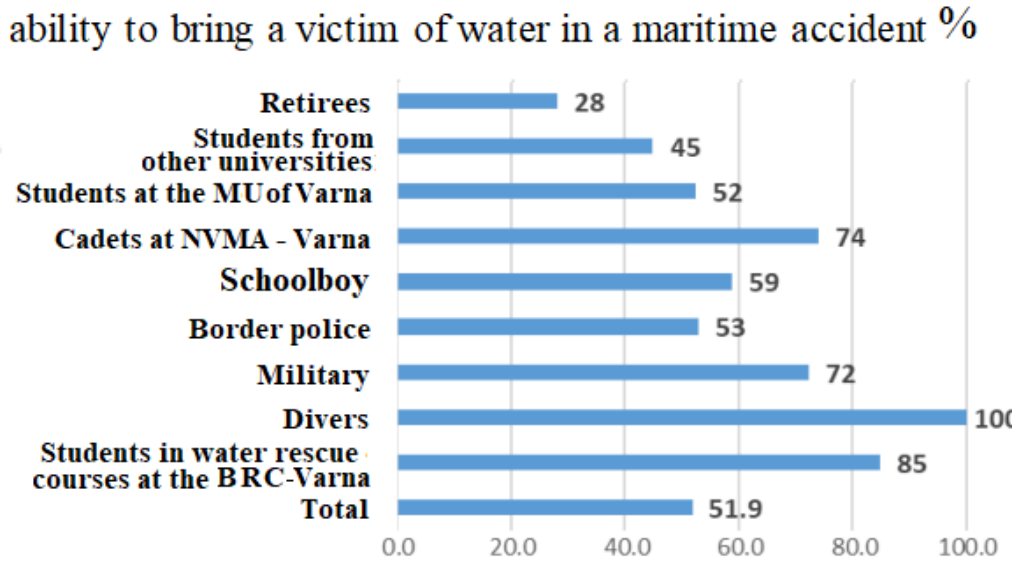
The specifics of first aid for drowning are known to less than half of the respondents. Knowledge increases slightly at higher educational levels. This shows a lack of awareness and commitment of the education system to the problems of water injuries. They are mainly the object of the activity of the Bulgarian Red Cross. In this direction, the Medical University of Varna permanently develops both research and development and educational activities with many programs in marine medicine for different categories of future medical professionals.

Comparison by social status:



Graph 25. Graphical presentation of swimming skills in different groups of respondents.

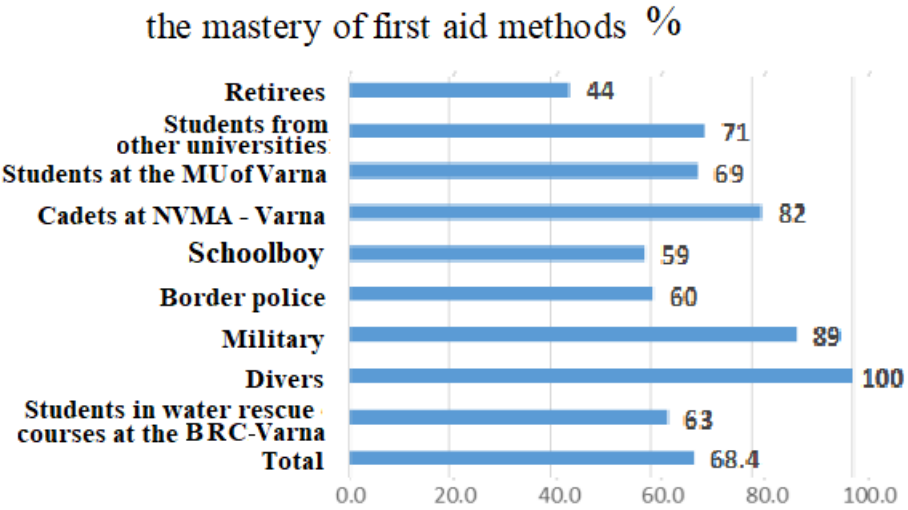
When analyzing the results obtained, the natural finding is that all marine professionals have swimming skills. Very close to this result are the professional military and border police - 94% and 89%, respectively. About ⅘ of the students at the Medical University, the cadets from VVMU and the students also know how to swim. Commenting on this, the values should not be mechanically transferred to the entire population, because the survey involves students from Varna, Burgas and settlements in these coastal areas, and students of these two universities can also be expected to have a legitimate interest in maritime issues. Students from other universities have a result very close to that of the general group. Retirees, although from the most active part of this social stratum, have a share of ⅔ unable to swim.



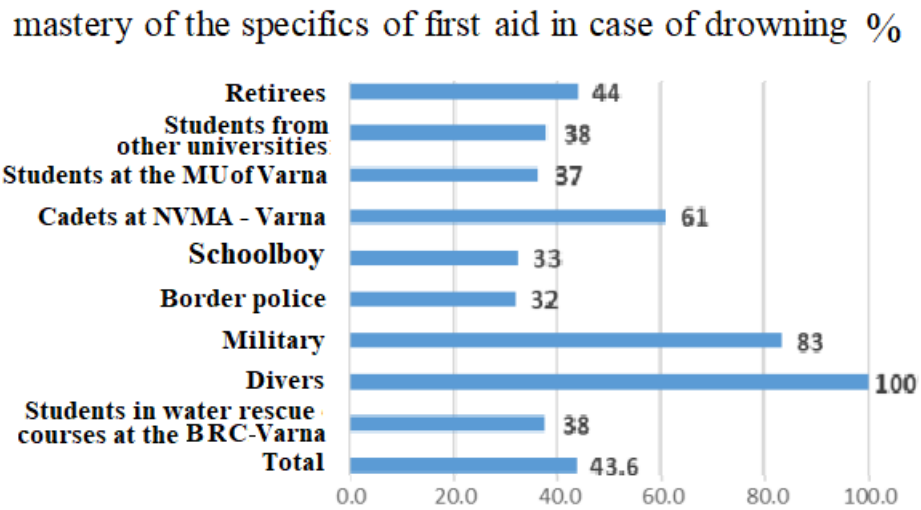
Graph 26. Graphical presentation of the ability to bring a victim of water in a maritime accident in the respective groups of respondents.

The ability to help a person caught in the sea is directly related to the swimming skills of the respondent. On the other hand, those who do not know swimming techniques can also save the drowning person and there are enough methods and means for that, as long as they know each other. The current survey shows that only 6% of those unable to swim can react adequately and try to save a critical water accident.

First aid is a set of basic skills that modernity requires from active members of society. The present study has shown a positive result in this direction. Professional soldiers are leading in this part of the study, with other groups also showing a predominance of first aid. Only retirees declare less than ½ skill.



Graph 27. Graphical presentation of the mastery of first aid methods in the respective groups of respondents.



Graph 28. Graphical presentation of mastery of the specifics of first aid in case of drowning in the respective groups of respondents.

The results on the mastery of the specifics of first aid in the most common form of water injury - drowning are the lowest values of all questions asked. Only professional soldiers show a good command of these specific methods. Divers due to their professional commitment - 100%, other categories of military and cadets VVMU respectively 83% and 61%.

Comparison by place of residence:

When comparing the results of the survey, it was found that there were no significant differences in the responses of residents of the large regional city and those of residents of small settlements in the district. For the seaside cities of Varna and Burgas, the ability to swim is declared by almost 4/5 and for the cities and districts far from the Black Sea coast a little more than half or almost 2/3. In terms of helping a person involved in a water accident to get out of the critical situation, again more than half of the respondents in the coastal areas declare the skills and those far from the shore less than ½.

Analysis of the results by place of residence. When reviewing the results of the question on swimming skills, they show that in the two large sea cities of Varna and Burgas almost 4/5 (79%) can swim. This, combined with the age analysis, shows an even higher percentage of 81.5 among people under retirement age. In other cities far from the sea this percentage is below 60%, ie. less than 3/5 can swim.

Table 10. Tabular presentation of the results of the answers to the various questions grouped by place of residence.

City / Question	Varna	Burgas	Ruse	Veliko Tarnovo	Sliven
1. Can you swim ?	79.1	78.7	58.9	58.3	55.2
2. Can you help a person in a water accident - get him out of the water ?	58.6	63.8	31.4	41.7	31
3. Do you know first aid methods ?	67.7	100	68.1	83.3	58.6
4. Do you know the specifics of first aid for drowning ?	44	44.7	41.6	58.3	44.8

All respondents declare a high degree of first aid skills. When asked about their knowledge of the specifics of first aid for drowning, less than half declare that they are aware of this feature. Only among the respondents from Veliko Tarnovo the percentage exceeds 50%.

Of the first aid methods, the best mastery of 50% shows artificial respiration, followed by cardiac massage. Only for the respondents from Sliven this ratio is in the opposite direction. The

other methods studied in the survey (primary wound treatment, cessation of external bleeding and immobilization in case of bone fracture) show mastery of less than 50% of the respondents. Only for those from Veliko Tarnovo the percentages are more than 50%.

Following the sources where the respondents received training for first aid, it was found that at most 47% of them have mastered the knowledge and skills that they declare in the system of the Bulgarian Red Cross. The percentage of respondents who received knowledge and skills in a family environment is extremely low - 13%, and from public media only 8%.

The creation and maintenance of a good water culture and especially a culture of safety in the marine environment is directly related to water injuries, to the medical damage of the individual victim and the population as a whole. From an early age (newborn and infant) man has some skills to cope with the challenges of the aquatic environment. Unfortunately, these skills are lost after the second / third year of life and as the body matures, the risk of being damaged by water increases. Without a targeted impact on the creation of swimming skills, the ability to help and self-help in maritime disasters is extremely limited. The creation and promotion of water culture, including the prevention of water injuries should begin in early childhood. The developed skills for physical, technical and mental preparation should be maintained throughout life. In this direction, the Bulgarian Red Cross has a primary role, which since 1964 has been engaged in water rescue activities.

Water injuries in accidents at sea in Bulgaria, despite the growing risk factors, show a lasting trend of limiting damage and casualties. In recent decades, the majority of deaths from drowning have been in indoor freshwater natural or artificial pools. This trend is the result of in-depth systematic activities of many organizations, institutions and thousands of responsible professionals and lovers of the sea. To reduce water injuries at sea, the activities are directed in two main directions - prevention of accidents and providing effective assistance in such cases. In determining the direction of preventive work to reduce water injuries at sea, it is especially important to determine the target groups of the population. They are structured according to different criteria and require a different approach, although the goal is the same - to increase safety.

Priority I - specialists directly involved in providing assistance to those affected by water injuries: lifeguards at sea and others. water areas; participants in voluntary disaster response teams; marine professionals; VVMU cadets; students from different medical specialties

Priority II - persons whose profession assumes a higher risk of being victims or rescuers:

teachers; coaches; police officers; border police; firefighters

III priority persons from risk groups due to age, activities, etc .: students; children in kindergartens; athletes; working in tourism

IV general group - labor collectives; members of society not covered by other categories; living along the coast and vacationing in seaside resorts; traveling by sea

Persons designated as Priority I require the highest level of competence in respect of water injuries at sea. The training of water rescuers is carried out in accordance with the standards set out in the "Ordinance on water rescue and protection of water areas.". A special emphasis is on maintaining the qualification. Every calendar year, practicing lifeguards pass the control for confirmation of legal capacity, including both coverage of swimming regulations and practical exam on DAC. In order to maintain good theoretical readiness, a short printed form - "Memo" with the most important instructions has been prepared and provided. In order to maintain the high level of qualification of the lifeguards and the members of DERBAC during the summer season, a “City Water Rescue Championship” is organized, for active lifeguards in which teams from all over the country participate. The Water Rescue Conference in the water rescue week expands and updates the methods of professional assistance in water injuries. For students from different medical specialties, the topic of safety and medicine in the marine environment is taught in the elective course "Marine Medicine" for the specialty of medicine, for the specialties Nurse and Midwife in the Optional discipline "Marine Medicine", and in the specialty "Health Management and Medical -social care "in the elective course" Marine Health, Medical Care of Marine Facilities and Coastal Zones ". Students develop term papers on important topics and participate in scientific conferences. Special textbooks are issued. Specialized training for medical professionals "Professional conduct in case of accidents on the beach" has been introduced in the system of postgraduate training of MU-Varna. The topic of water injuries at sea is included in programs for continuing education of doctors and health care professionals. A program for postgraduate training of doctors for the medical specialty "MARINE MEDICINE" was created and proposed to the Ministry of Health.

For the persons from the II priority group specialized trainings are conducted, the so-called "Water saving minimum". These are organized at the state level by the Ministry of Interior and at the regional level by regional departments of the Ministry of Interior and education directorates. The training is carried out by BRC instructors and focuses on the specifics of DAC in water injuries.

For the III priority group, outsourced trainings are conducted in the classroom in schools. Open lessons are organized in kindergartens. We are working on national programs, such as "Friends with Water" and regional ones - "Find a savior in yourself." Particularly effective and engaging for children and young people are the sports tournaments "Young Savior" and "Championship for preschool children" held in Varna. Paper and electronic aids are issued for children and parents (Appendices 53 and 54). Elderly people are not ignored, especially those in coastal settlements and others with potential risks of water injuries. Specialized courses are held for them.

The IV priority group is the most massive. The work on prevention of water injuries in the widest scope and includes the publication and distribution of many materials promoting the issue. Prevention is aimed at all members of society. Courses are held in labor collectives, companies, state and municipal structures. Interview reports are broadcast, specialized films are made, books are published. Popular materials for counteracting water injuries at sea are created and distributed. There are public campaigns, such as Water Rescue Week. Their purpose is:

- Familiarity with the potential risks of the marine environment - what dangers it hides and how to find out about them

- What are the regulated ways to protect people in the sea and coastal areas from water injuries, including entertainment, industrial, transport and others. activities

- How to act to protect their own health and life and how to provide self-help for water injuries

- How to help another or others affected by a water accident in both its aspects - the first aspect of removing the victim from the critical situation, removing the water from the risky environment and the second aspect of providing timely and adequate medical care, most often called medical care.

A significant risk group to which prevention is directed are tourists and temporary residents in marine and coastal environments. They have a variety of personal, cultural, everyday, emotional and more. factors can potentiate marine distress. We work with tourists systematically, as the materials are prepared in many foreign languages (English, German, Russian, Romanian… ..) in order to be accessible and understandable.

The creation and functioning of a complex model for counteracting water injuries at sea requires intensive work, combining the efforts of many structures involved in the subject. On the one hand are the educational institutions, state and municipal authorities, business structures, and

on the other many informal public organizations. It is crucial that this activity is carried out systematically, correctly and methodically. For the systematic counteraction of water injuries at sea, it is important to upgrade the knowledge and methodologies with scientific developments. In 2008 in the city of Varna was established a unique association of water rescue specialists with the status of a Red Cross. Since 2011 it has been accepted as a collective member of the Union of Scientists in Bulgaria. Scientific research is conducted systematically. Regional and national projects are developed and implemented: "Infrastructure for sustainable development in the field of marine research, linked to the participation of Bulgaria in the European infrastructure EURO-ARGO", "Find a savior in yourself", "Raising awareness of older people about disaster response, accidents, catastrophes and first aid".

The developed model for prevention and counteraction of water injuries at sea demonstrates its effectiveness with the lasting tendency to reduce the number of deaths in sea waters in recent decades. The situation is dynamic and requires constant upgrading of the system.

In the implementation of activities under the fourth task, the following conclusions and summaries were reached:

1. The summary of the results of the comparison of the different categories of subjects shows a relatively high readiness for first aid in the general case of 68.4% and a lower one for water injuries in the marine environment 43.6%.

2. This should not be mechanically transmitted to all members of society, because the survey is aimed at the active part of the population of appropriate age groups.

3. The respondents received the preparation for rendering help and self-help mainly from the system of the Bulgarian Red Cross, less from educational institutions and to a very low degree from the family and the mass information providers (media)

4. No significant differences in the results are established depending on the place of residence in the different districts or according to the size of the settlements.

5. The existing system for preparation of the population for prevention and counteraction of water injuries at sea is diverse, wide-ranging and effective. Proof of this finding is the decrease in the number of deaths from water injuries in sea waters on the Bulgarian coast reached a level of 1.2 ‰ per 100,000 according to WHO measurements.

6. This does not mean stationing or any other form of limiting its development, on the contrary, the changing situation requires constant upgrading and updating.

3.5. Exploring the possibilities for creating a model for inter-institutional interaction in the event of incidents, accidents and catastrophes along the coast related to water injuries in territorial waters and areas of responsibility in the Black Sea

In the event of incidents, accidents and catastrophes along the coast, in territorial waters and in areas of responsibility, the issue of human survival at sea is always at the forefront. It is the responsibility of the maritime states to take all possible measures to ensure the safety of both shipping and coastal facilities (industrial and recreational) and even the unguarded coastline. The role of the institutions, the maritime municipalities and the public structures involved in the topic is manifested in the implementation of a policy for increasing safety, as well as in preliminary, current and subsequent control to ensure compliance with safety requirements.

Survival in an aquatic environment in the event of disaster depends to a large extent on critical infrastructure, and blocking or disrupting it can compromise or hinder an organized search and rescue system. Such a situation, as well as various features of the occurrence and course of maritime accidents prompt to look for ways to include other structures to overcome accidents, in general and in particular the medical damage. In this respect, MU-Varna has both three vessels and excellently trained medical and maritime specialists ready to participate in maritime rescue operations. Priority is given to a 9-meter high-speed motor boat, reaching any point on Varna Bay within a few minutes - Cape Galata in 5 minutes to Cape Ilandzhik (Evksinograd) in 10 minutes. These parameters guarantee satisfactory control over the situation of a maritime accident in the bay, both in the part for reaching the scene of the accident and for providing adequate medical assistance.

The students studied at MU-Varna are regularly prepared in the elective course "Marine Medicine" from 2008, in which as an integral part of the curriculum is assistance in water injuries and all types of medical problems at sea. In addition to medical students, students from the specialties "Nurse" and "Midwife" and those from branches of the University of Sliven and Veliko Tarnovo are trained in this training. From the academic year 2020/2021 in the master's program of the specialty "Health Management and Medical and Social Care" training is conducted in the discipline "Marine Health, Medical Care of Marine Facilities and Coastal Zones". As part of the training in maritime medicine, students can receive kayaking training and sail aboard the rescue ship of the Bulgarian Red Cross "Metropolitan Simeon". The Disaster Medicine curriculum includes a 'Crisis Management' activity on board a university vessel, which deals with the safety and medical provision of the ship. When choosing a sport, students have the

opportunity to master both swimming and sailing.

To create skills and algorithms for response to a maritime incident within the festival "Sea and Health", organized by MU-Varna, models for action in case of accidents at sea are being developed. Physiological examinations are performed during experimental dives. Together with DERBAC - Varna, a demonstration rescue is organized in case of an accident in the 100-meter coastal zone with the participation of specialists from the SJC, VVMU and MU vessels. In the National Naval Exercise with international participation - "Breeze 2019" Medical University - Varna participates with a motor boat, medical team and a professional rescuer from the Bulgarian Red Cross. The topic of the exercise is "Conducting a naval security operation by the Naval Forces (Navy) of the Republic of Bulgaria, with the participation of multinational allied forces, together with the forces of government agencies, agencies and non-governmental organizations." In fulfilling the goals set by the Navy - "Improving the compatibility and interaction between the Navy, government agencies and civil society organizations during the rescue operation at sea (Rescue Operation)" took into account the time of the team of MU-Varna. They are - 4 minutes to reach the scene of the accident in Varna Bay and 2 minutes to intervene with the lifeguard and remove the distressed from the sea on board. Medical assistance was provided immediately during the evacuation of the victim to the port at the Sea Station.

For the next stages of the developed algorithm for interaction, measurements were made with a resuscitation vehicle of CSMP-Varna in a real urban road environment. The maximum time for the arrival of the emergency medical transport to the port at the Sea Station and the reception of the patient is 12 minutes. It is then transported to a specialized medical institution. There are three options, respectively:

 2.9 km - 5 minutes and 47 seconds to MHAT "St. Anna" - Varna, which provides assistance to all severely injured in maritime disasters in the shock room of MSO (Multi-profile emergency department) and OAIL (Department of Anesthesiology and Intensive Care).

 5.9 km - 12 minutes and 5 seconds to MHAT-Varna at the Military Medical Academy - KAMIM (Clinic of Anesthesiology, Marine and Intensive Care), which provides assistance with water tarvmatism. OHMM (Hyperbaric and Marine Medicine Department) provides assistance in underwater injuries and all diving diseases. Clinic for intensive treatment of acute poisoning and toxicoallergies provides assistance in pathogens affected by marine toxins and subsequent trauma.

 6.2 km - 13 minutes to the University Hospital “St. Marina ”(University Hospital Sveta

Marina) provides assistance to all severely injured in the Emergency Departments for Children and Adults, KAIL (Clinic of Anesthesiology and Intensive Care) and has all kinds of specialized clinics and wards.

Each does not deny the others, but on the contrary complements the possibilities for reaction according to the individual characteristics of each victim of water trauma. Another aspect is the increase in the possibility of receiving many victims in the cases of major maritime accidents on the Bulgarian coast.

As a result of the experimented model, it was found that in the event of a Maritime Incident in Varna Bay, good coordination of joint actions of the Medical University-Varna, BRC-Varna and CSMP-Varna can ensure that a victim of an accident at sea reaches intensive care within at 16-26 minutes. The experimented scheme of interaction seeks structural simplification, without underestimating the specifics and professionalism of individual participants to solve acute problems with water injuries. The empirical method was chosen in view of the basic scientific approach - evidence-based analysis.

In the implementation of activities under the fifth task, the following conclusions and summaries were reached:

1. The maritime assistance system is far from comprehensive and there are additional opportunities for development.

2. The search for new forms of interaction of different structures and institutions in counteracting water injuries expands the possibilities for reaction in case of accidents at sea.

3. The creation and testing of good informal organizational forms provides options for flexibility in maritime disaster relief systems.

4. The good communication between the Bulgarian Red Cross-Varna, Medical University-Varna, the Structures of the health system, the Ministry of Transport, the Ministry of Defense and others. related to water injuries in accidents at sea are realized in the simulated play of episodes with rescue in the area of responsibility of the Republic of Bulgaria. The careful analysis of the nationally and regionally played out situations of incidents with water injuries in the Varna Bay, as well as the specially organized measurements in the course of the present research give grounds to develop exemplary models and algorithms.

5. Such a system can successfully include various structures of informal civic organizations - tourist and sports clubs, business structures, associations with scientific and humanitarian goals, etc.

4. General conclusions

In medical practice, decisions are often based on a certain level of facts, which is less than absolute proof. The more and more diverse the information collected and analyzed, the more adequate are the conclusions and the proposed approaches for ensuring safety in maritime practice with regard to water injuries.

 Water injuries at sea arise both from natural disasters - tsunamis, high wind waves, icing… and from man-made accidents with transport, infrastructure, industrial facilities, professional activities, sports and entertainment. It is not possible to influence the climate, physical and seismic processes. Even modern early assessment and forecasting systems are not reliable enough.

 The development of methods to reduce injuries from water injuries should be directed, on the one hand, to continuously improving the safety of maritime activities and, on the other hand, to improving and maintaining good training of potential victims and rescuers for self-help and first aid in maritime accidents, leading to water trauma.

 As the statistics worldwide describe 36 tsunami waves caused by earthquakes that took more than 2000 victims, in Bulgaria for historical reasons such statistics cannot be presented. The presence of an earthquake zone along the Black Sea coast - Shablenska with the last earthquake on March 31, 1901 does not completely exclude the possibility of a series of unusually high and destructive waves. Of the other causes of tsunami waves - landslides, volcanic eruptions or collisions with space objects, landslides are only available in the last century. There are areas of landslides at the moment, but they are not sized to cause tsunamis. The high wind waves affect the Bulgarian shores almost every year. The victims are few - from one to three. Although there are many settlements with low altitude in Bulgaria, the risk to the population from high waves is not pronounced, as in other countries with low coasts in the Indian and Pacific Oceans.

 Of the anthropogenic accidents, shipwrecks take the most victims of water injuries at sea. If we make a comparison between the biggest sea disaster for Bulgaria of this type - the sinking of the ship "Struma" in 1942 with the biggest one for the United Kingdom - the sinking of the "Titanic" in 1912 we will find that the relative share of the population in Great Britain at this moment it is 0.036 ‰ and for our country it is 0.1 ‰, ie nearly three times more significant loss. To date, the lack of Bulgarian passenger liners and the small crew of Bulgarian ships suggests multiple casualties from water injuries in shipwrecks.

 The main potential victims of water injuries at sea on the Bulgarian coast are the people who use the sea goods for recreation, sports and entertainment. Next in line are those living in the coastal areas, those who are on business and passing through them. All activities should be focused on them, both for the prevention of water injuries at sea and for improving the skills of assistance and self-help in case of maritime accidents.

 Marine experiments in their medical part contribute significantly to understanding the mechanisms of physiological and mental adaptation of man in the unfamiliar marine environment. Every research opportunity should be used to improve the safety of those living in the marine environment.

 Research in the marine science program shows good physiological indicators of those dedicated to marine professions. The volunteers studied during their training for lifeguards reported a relatively small change in their physical functional parameters and greater progress in their mental confidence and stability. There was also an increase in the level of stress resistance in the students after passing a training course for lifeguards.

 A study of the readiness of different categories of persons to provide assistance in a situation with water injuries at sea revealed a high level of preparedness for first aid in the general case of an accident (68.4%) and significantly lower that in case of water injuries at sea environment (43.6%). This leads to an increase in the activities of specialized training in this direction for all persons potential participants in rescue operations at sea.

 The search for new forms of interaction of different structures and institutions in counteracting water injuries expands the possibilities for reaction in case of accidents at sea. Such are carried out in good coordination between MU-Varna, BRC, CSMP, state, municipal and civil structures.

Marine water injuries are undoubtedly a major global public health problem with significant potential for impact. Effective prevention requires programs and policies that address certain risk factors. Local data collection or monitoring is needed to identify specific factors related to water injury in a given region. There may be large variations in time and place, as water injuries may be related to several types of daily and / or recreational activities (eg fishing, boating, swimming), different types of water exposure (eg in the oceans, gardening). wells, lakes, swimming pools and baths) and other risk factors (eg risk behaviors, including alcohol use and product safety factors). Ensuring safety for those living in the marine environment is directly linked to ensuring safety for emergency responders. This is done through measures based on a comprehensive research program.

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Created and installed in the public WEB environment video materials on the topic of prevention of water injuries:

 "The Green Devils of Varna"- http://mu-vi.tv/Top-Videos/Pages/ MUVideoCreationFromWebPartmoviesrubrics_33_7_1502283842.aspx 9.08 2017

 Traditions and culture for protection of life and health on the Varna coast http://mu-vi.tv/Top-Videos/Pages/MUVideo CreationFromWebPartrubrics_33_6_1539177824.aspx 10.10. 2018

 World Water Day http://mu-vi.tv/Top-Videos/Pages/MUVideo CreationFromWebPartrubrics_33_63_1616056899.aspx 18 03. 2021

6. Yields.

Scientific-theoretical

1. Identification and full description of the harmful effects of the marine environment on the human body. Distinguishing water trauma from other groups of diseases of marine professionals unrelated to the marine environment.

2. Expanding the perimeter of training and research in marine medicine covering the various aspects of the relationship man sea and different people potential victims of water injuries - marine professionals on shore and on the high seas, travelers, water sports, researchers in various fields of marine sciences , holidaymakers and other residents at sea.

3. Analysis of the readiness of different categories of Bulgarian citizens, potential rescuers to provide assistance in case of water injuries at sea.

Scientific and practical

4. Summary and analysis of the causes leading to injuries in sea water on a global scale and their dimensions in Bulgaria.

5. Analysis of the medical aspects of the marine experiments carried out in Bulgaria with a view to reducing and / or avoiding water injuries. Summarizing the contributions of the Bulgarian marine experiments. Creating an exemplary scheme for studying the changes occurring in the body during a marine experiment and appropriate laboratory support.

6. Creating a model for the organization of a laboratory in marine medicine. It is partially equipped. Research related to the safety of maritime professionals has begun. There are registered and analyzed results, some of which have been published.

7. Creation and implementation of wide-ranging measures for prevention and counteraction of water injuries, including practically all age and social groups of the society. Creation of printed and electronic materials on topics including water trauma, its prevention and measures and ways to overcome medical injuries.

8. Experimentation, reporting and analysis of options in the planning and management of medical activities in case of maritime accidents, supplementing the existing systems of action in crises in the water area.

7. Presentation of the works from the dissertation at scientific forums in 2020

1. D. Stavrev, V. Raynova, P. Nikolova. Development of a model for functional assessment of maritime professionals preparing. Conference "Marine Research, Innovation and Infrastructure for Public Health Prevention" is part of the VI Festival "Sea and Health" May 22, 2020.

2. P. Nikolova, M. Moskova, G. Tomova, D. Stavrev. First results of a study of some morphological and physiological indicators of the respiratory system in different categories of persons potentially residing in the marine environment. Conference "Marine Research, Innovation and Infrastructure for Public Health Prevention" is part of the VI Festival "Sea and Health" May 22, 2020.

3. G. Tomova, D. Stavrev, Organization of the medical part in overcoming the consequences of the first emergency flooding exercise in Varna Bay. . Conference "Marine Research, Innovation and Infrastructure for Public Health Prevention" is part of the VI Festival "Sea and Health" May 22, 2020.

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7. D. Stavrev, Th. Rockov, R. Nedeva, Psychological aspects of the preparation and conduct of a sea expedition ABORA IV FIFTEENTH INTERNATIONAL CONFERENCE ON MARINE SCIENCES AND TECHNOLOGIES Black sea 2020 VARNA SCIENTIFIC AND TECHNICAL UNIONS, October 28th, 2020, Varna, Bulgaria

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