

ERGONOMICS STUDY OF STRETCHER FOR RESCUER TO LIFT DROWN BODY

Muhammad Husaini Rahmat, Ruhaizin S, Rosalam CM, Hassan A, Khairul Manami K and Industri S

*Department of Industrial Design, Faculty of Design and Architecture, Universiti Putra Malaysia 43400 Serdang Selangor, MALAYSIA.****Corresponding author: Ruhaizin S**Email: ruhaizin@upm.edu.my

ABSTRACT

Drowning is one of 10 leading causes of death in every region of the world especially in the picnic and recreation. Statistics from Fire and Rescue Department showed an average of 700 people drown each year in this country. There were also cases where casualty to rescuers during the Save and Rescue Operation (SAR). As the incidents increased, the task of rescuers and equipment used should be reviewed. Issue How to ease rescuer task and safely lift underwater drown body. Problem Statement Difficulties arise during lifting drown body from underwater to the surface due to certain circumstances. This involved safety to rescuers, process of rescuing and time consuming of the operation. Objective The objective of this study is to determine the efficient ways of lifting drown body based on rescuers preferences. From the results, new stretcher design parameters will be established. Method Thirty rescuers from two Water Rescue Teams namely PPDA Putrajaya and PPDA Shah Alam Branches participated in this study. They are 24 male and 6 female aged between 23 to 51 years with mean of age at 29.5 year and experienced in SAR. Instrument Questionnaires were used to identify factors contributed to success or failure of any SAR operation. Likert scale questions were used to measure their preferences. Data then processed using statistical software (SPSS). Results Findings shows that all respondents agreed that lifting method is the most significant factor affecting their task performance, safety and time consumes. Meanwhile 83.3% of them strongly agreed and 16.7% agreed the usage of proposed floatable stretcher to lift drown body in their future SAR Operations.

Keywords: Rescuer, stretcher, drown body, task performance, safety, time consume

INTRODUCTION

Drowning is one of 10 leading causes of death in every region of the world especially in the picnic and recreation. Statistics from Fire and Rescue Department of Malaysia stated an average of 700 people drown each year in this country [1]. There were also cases where casualty to rescuers during the Save and Rescue Operation (SAR). As number of the incident increases, the task of rescuers and equipment used should be reviewed.

The issue of this study is to ease rescuer task and safely lift underwater drown body to the land. The problem statement is regarding difficulties arise to rescuers during lifting drown body from underwater to the surface and to the ground due to certain circumstances. This involved safety to rescuers, methods of rescuing and time consuming of the operation. The objective of this study is to determine the efficient and safer ways of lifting drown body based on rescuers preferences. From the results, new stretcher design parameter will be established.

According to the Department of Statistics, an average of 596 people died from drowning in a year between 2009 and 2013 [1]. Almost half of the drowning cases involving children and teenagers. For the year 2016, statistic shows 260 drown cases while in 2017 there were 327 cases. By February 2018, the death toll was 65 [2]. Deaths due to drowning in Malaysia can be taking

as serious matter because the case average almost one involved in a day. Among the factors that could cause suffocation including unrestricted access on the swimming area, the lack of swimming knowledge and understanding of water conditions, ignorance, disregard or misjudge the level of water hazards, lack of supervision of visual continuous and lack of awareness and education about water safety and the ability to save lives (Bernama, 2016) [3].

According to World Health Organizations (WHO) to one of options to prevent drowning is teaching children and adult swimming and water safety (World Health Organization, 2014) [4].

According to statistics, almost half of the cases concerned drowning involving children and adolescents aged between five and 14 years. The latest data from the Fire and Rescue Department showed an average 700 people drown each year in this country, especially in the picnic and recreation (New Straits Time, 2017) [5].

As state by President of Penang Malay Association Tan Sri Mohd Yusoff Latiff said it is about time for the government to look it as a serious problem about the drowning case coming from swimming activities faced by the society. It is important for the government to give serious attention especially to give swim education for the younger generation so they do not get stuck with unwanted incidents (Bernama, 2017) [6].

Figures 1 to 12 show several types of SAR Operation done by PPDA staff. Figure 13 on the other hand shows one of a tragic case where casualty happened to six of the PPDA rescuers.



Figure 1: PPDA staff at work in sea SAR



Figure 2: Lifting drown body from the sea



Figure 3: Lifting drown body from the river bank



Figure 4: Another SAR Operation in a river

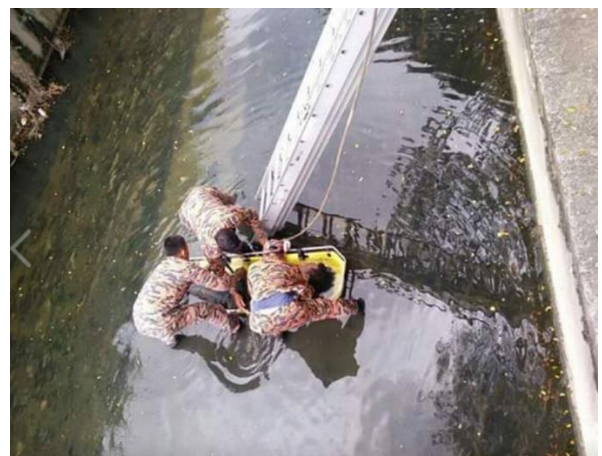


Figure 5: Stretcher, rope and portable ladder were used to lift drown body from a drainage system



Figure 6: Rope or tag line is commonly used in SAR Operation



Figure 9: SAR Operation of drowning case in a lake



Figure 7: SAR Operation on a rocky waterfall. Without stretcher, it is hard to work on uneven surfaces



Figure 10: SAR Operation during flood. Transferring sick person to a safer place for medical treatment



Figure 8: Stretcher was widely used in SAR Operation. Transferring a drown body from a river bank to the land



Figure 11: SAR Operation during flood. A bedridden elderly was transferred from her home to a safer place known as Flood Transfer Centre



Figure 12: SAR Operation to save victims from a plunged vehicle into a river



Figure 13: A tragic SAR Operation in a lake at Taman Putra Perdana, Puchong, Selangor where six PPDA staff was drowned on October 3rd, 2018

METHODOLOGY

In order to identify the present state of SAR and future improvement, interview with Director of FRDM Putrajaya and Director of FRDM Selangor were carried out. This includes discussion on the Standard Operation Procedure of SAR documents SOP No. 6.2 and SOP No. 2.4 [7]. From their given information, set of questionnaire was designed. Series of data collection then took place. Using closed-ended questions; factors contributed to success or failure of any SAR operation, pull-out technique, lifting methods, acceptance of other methods and acceptance to use floatable stretcher were measured. Respondent's preferences were measured using Likert scale questions. The collected data were processed using SPSS statistical software (version 21.0, SPSS Inc., Chicago, IL, USA) and analysed using descriptive statistics to get the results. Thirty rescuers from two Water Rescue Teams namely PPDA Putrajaya and PPDA Shah Alam Branches participated in this study. They are 24 male and 6 female aged between 23 to 51 years with mean of age at 29.5

year. They were professionally trained and have various experienced in SAR.

RESULTS

Findings show all respondents agreed that lifting method is the most significant factor affecting their task performance, safety and time consume. Meanwhile 83.3% of them strongly agreed and 16.7% agreed on the usage of proposed floatable stretcher to lift drown body in their future Save and Rescue (SAR) Operations.

Based on present technique, 80% of PPDA rescuers prefer to use tie rope (tag line) and pull the victim out from the water. Table 1 shows their preferences.

There are six factors investigated for SAR successful. They are staff skill, Standard Operation Procedure, rescuing equipment, weather, individual initiative and geographical condition. It was found that out of 6 factors contributed to the successful of any SAR Operations, rescuing equipment was the highest rated factor (30%). This is shown in Table 2. The result shows the important of rescuing equipment and attention should be given to improve the design, functionality and effectiveness over time. Although rescuing equipment need further redesigning and improvement, it does not mean the present equipment are less workable. As far as the research and development is concern, there are always room for rescuing equipment design improvement.

Table 3 below shows that the common failure of present SAR Operations are due to weather condition. In the case of PPDA SAR, it also refers to under water current and surface water waves that have significant effect while rescuing.

Table 4 shows all PPDA staffs prefer lifting method to pull out drown victim. They also open to accept any efficient method for their future tasks as shown in Table 5.

Table 1: Technique of pull out drown victim

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Tie with rope & pull out drown body	24	80.0	80.0	80.0
	Wear life jacket to the victim	6	20.0	20.0	100.0
	Total	30	100.0	100.0	

Table 2: Preferences factors of successful SAR

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Skilful Staff	5	16.7	16.7	16.7
	SOP	6	20.0	20.0	36.7
	Rescuing Equipment	9	30.0	30.0	66.7
	Weather	4	13.3	13.3	80.0
	Individual Initiative	2	6.7	6.7	86.7
	Geographical	4	13.3	13.3	100.0
	Total	30	100.0	100.0	

Table 3: Factors contributed to SAR failure

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Rescuing Equipment	1	3.3	3.3	3.3
	Weather	13	43.3	43.3	46.7
	Individual Initiative	9	30.0	30.0	76.7
	Geographical	7	23.3	23.3	100.0
	Total	30	100.0	100.0	

Table 4: Lifting is the most preferable method to pull out drown body

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	30	100.0	100.0	100.0

Table 5: Acceptance to use more efficient rescuing method

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	30	100.0	100.0	100.0

Table 6: Acceptable to use the proposed floatable stretcher

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	25	83.3	83.3	83.3
	Agree	5	16.7	16.7	100.0
	Total	30	100.0	100.0	

Table 6 shows that they accept the use of proposed floatable stretcher to lift drown body. Facts from Table 4, 5 and 6 reflect that floatable stretcher could be future efficient and safer way for rescuers to lifting drown body. Other design parameters could be based on these factors.

Table 7 shows the finding summary of this study that reflected the rescuers preferences towards the investigated variables.

Table 7: Rescuer Preferences

No.	Rescuer Preferences	Percentage
1	Pull-out drown victim (tie with rope and pull out)	80%
2	Successful factors of SAR operation (rescuing equipment) highest out of 6 factors	30%
3	Failure factors of SAR operation (weather condition) highest out of 4 factors	43.3%
4	Lifting method	100%
5	Acceptance of more efficient method	100%
6	Acceptance to use floatable stretcher (83.3% Strongly agreed and 16.7% Agreed)	100%

DISCUSSION

Research findings show rescuers accept improvement of their current equipment to perform SAR tasks. Lifting method significantly affect their task performance, safety and time consume. The proposed stretcher design will focus on improving current lifting method. The design is suggested to use air bags that can be inflate under water and deflate after use. Minimum of two divers is needed to tie the drown body to the stretcher and inflate the air bags. As the stretcher quickly floats to the surface, they have to swim up and escort the stretcher. The on-land or ground rescuers will then pull the stretcher from the water surface to the river bank, beach or the ground for further actions.

Proposed Design

A proposed floatable stretcher design was drawn based on the finding and considered the basic design parameters. Detail design will be produced in the near future for manufacturing purposes. Figure 14 shows the deflated state of the stretcher while Figure 15 shows the inflated

state. Credits should be given to Mr Amil Faesal for producing the CAD drawings.

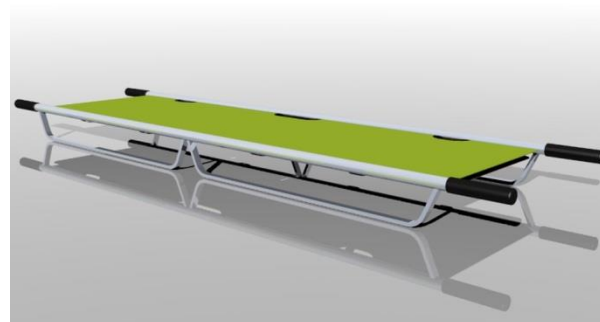


Figure 14: The deflated state of the floatable stretcher

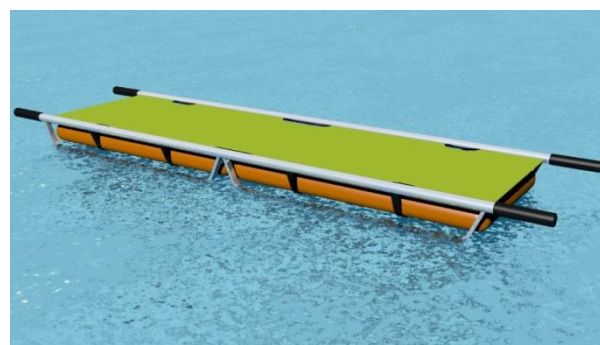


Figure 15: The inflated state of the floatable stretcher

Proposed operating process of the floating stretcher

1. Anchor with rope on the bank or anchor to the rescue boat.
2. Submerge it to the identified drown body location with two assisted rescue divers.
3. Tie the body and inflate the stretcher's air bags.
4. Once floated to the surface, other rescuers will pull the stretcher to the bank or pull into the boat.
5. Once grounded, deflate the stretcher's air bags.
6. Continue with normal rescuing SOP.

CONCLUSIONS

The Standard Operating Procedure (SOP), well-equipped and well-trained staffs are three common aspects of preparation in rescuing live or drown victim. But, other factors than that such as weather, geographical nature of sites and dedications of staff could contributed to successful or unsuccessful any SAR operations. Certain present equipment still could be redesigned or innovated to improve efficiency, time consume, safety to rescuers and successful of future SAR. This

study confirmed that rescuers agreed to the proposed idea of designing ergonomic floatable stretcher as it was predicted to ease and shorten the process of lifting drown body as well as increase safety to rescuers. For future works, the design parameters and functional criteria will be identify and establish in realisation of this floatable stretcher. This will be followed by prototype fabrication, testing and validation. This complete design process could give the answer either the floatable stretcher really works to achieve the objective of this study.

ACKNOWLEDGEMENT

Authors wish to thanks Fire and Rescue Department of Malaysia generally and specifically to Mr Md. Hilman Abdul Rashid, Director of FRDM Putrajaya, Mr Othman Abdullah, Director of FRDM Selangor and participated PPDA personnel for their corporation and made these data collection possible.

REFERENCES

1. Bernama. (2017). 500 children drown each year | The Malay Mail | <https://www.malaymail.com/news/malaysia/2017/10/11/500-children-drown-each-year-research-finds/1484941> Retrieved on June 7, 2018.
2. Berita Harian (2018). Statistik lemas 2018 membimbangkan. <https://www.bharian.com.my/berita/kes/2018/02/391988/statistik-lemas-2018-membimbangkan-bomba>. Retrieved on July 31, 2019.
3. Bernama. (2016). BERNAMA - Lemas: Semua Pihak Perlu Main Peranan - Lee. Retrieved on May 26, 2018. <https://www.mstar.com.my/lokal/semasa/2016/12/10/lemas-prihatin>
4. World Health Organization. (2014). Preventing drowning: an implementation guide | Page 16| Retrieved on June 7, 2018. https://www.who.int/violence_injury_prevention/drowning/drowning_prevention_guide/en/
5. New Straits Times. (2017). Database of drowning cases vital | NST Online | TAN SRI LEE LAM THYE. Retrieved on June 7, 2018. <https://www.nst.com.my/opinion/letters/2017/10/293578/database-drowning-cases-vital>
6. Bernama. (2017). BERNAMA - Kelas Renang Perlu Diperkenal Dalam Aktiviti Kokurikulum Di Sekolah. Retrieved on May 26, 2017. <http://www.bernama.com/bernama/v8/bm/ge/newsgeneral.php?id=1341131>
7. Laporan Jawatankuasa Siasatan Kes Kematian Enam (6) Orang Anggota Bomba Semasa Operasi Mencari dan Menyelamat. (2019). Kementerian Perumahan dan Kerajaan Tempatan. Retrieved on July 31, 2019. http://www.kpkt.gov.my/resources/index/user_1/Attachments/laporan_khas/Laporan_JK_Siasatan_Kematian_6_Orang_Anggota_Bomba_Semasa_Operasi_Mencari_dan_Menyelamat.pdf