




A preliminary studies to assess public knowledge of beach safety in east coast Malaysia

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Abstract

Rip currents are one of the coastal hazards that put Malaysian beachgoers in a risky position. Most of the drowning accidents that occur at beaches worldwide are closely associated with this phenomenon. Research on rip currents is needed to build an effective measuring tool to overcome these issues. However, to date, research on rip currents is mainly focused on its physical aspects, commonly concentrating on the processes that influence and relate to the rips' generation. As an effort to minimize the negative consequences exerted by the rips, there is an urgent need to enhance the rip-related research in the social sciences field. Comprehensive research that includes all fields might produce more beneficial and reliable information. Therefore, this study intends to examine the level of public understanding of rip currents and beach safety knowledge of the Teluk Cempedak Beach. A questionnaire comprising 5 sections and 31 questions was developed as the primary tool in this study. A total of 60 beachgoers have been surveyed for this preliminary study through a questionnaire to investigate their demographic profile, frequency of visiting the beach, swimming ability, and their knowledge of rip currents and beach safety. The results show that the beachgoers have poor knowledge of rip currents. Conversely, they are observed to have higher beach safety knowledge. Also, the findings help in filling the research gaps of this study in terms of the instrument used for the data collection procedure. Above all, an extension of this study may contribute to the development of beneficial tools in assessing public knowledge on beach safety and rip currents throughout Malaysian beaches.

Keywords Rip currents · Public knowledge · Beach safety · Drowning

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1 Introduction

Beaches offer enjoyable environments that serve recreational and tourism purposes. Despite massive tourism and recreational activities, beach areas expose various hazards to visitors which they often do not recognize. This subsequently places those visitors in a risky environment. One of the most hazardous and worrisome beach hazards is known as rip currents. Having caused multiple drowning deaths and rescues throughout worldwide beaches, the rips have been unequivocally declared as one of the greatest deadly hazards for beachgoers (Castelle et al. 2016).

The rips refer to a type of current with the ability to pull victims offshore. As the rips could carry the victims to the middle of the sea, they are typically associated with drowning cases. United States Lifesaving Association (USLA) projected that more than 100 rip current fatalities have occurred annually in the USA (Brewster et al. 2019). More people in Australia die from rip currents compared to other threats such as floods, shark attacks, and bushfires (Brander et al. 2013).

In Japan, approximately 300 cases related to rip current drowning had been reported from 2003 to 2011 (Ishikawa et al. 2014). Interactions between natural factors including high wave height and large tidal range, as well as the presence of man-made coastal structures, have induced the existence of rips in Japan. Around 39 rip current fatalities are reported annually along the Indian coastline (Arun Kumar and Prasad 2014). The most conducive conditions that lead to the generation of rips along the Indian coastline include pre-monsoon, post-monsoon, and south-west monsoon. At one of the beaches in China, known as Dadonghai Beach, over 350 drowning incidents were recorded whereby most are linked to rip currents (Li and Zhu 2018).

In Malaysia, accidental drownings have been recognized as one of the five primary causes of deaths especially among children (Department of Statistics Malaysia 2019b). Around 15 drowning hotspots (high-risk drowning areas) have been declared in Malaysia by the Fire and Rescue Department (JBPM) relating to these incidents (Azizan 2019). For the first half of 2018, over 190 cases were reported, with death rates up to 82%. East coast regions of Peninsular Malaysia, such as Kelantan and Terengganu, recorded the highest number of drowning accidents (Amar-Singh et al. 2011). Similarly, records of drowning accidents along the Pahang coastline were also alarming. From 2006 to 2018, there were 31 victims of drowning accidents including both fatal and hospitalized non-fatal cases (Hamsan and Ramli 2020). Specifically, at the Teluk Cempedak Beach, Kuantan, eight deaths and three rescues were reported, the highest number of drowning victims compared to other beaches in the surrounding areas. However, the recorded number does not include under-reported drowning cases. The problem of under-reported cases might be associated with the systematic reporting system in Malaysia that is seldom undertaken. Despite the alarming drowning records, the major causes of the drowning accidents were rarely reported and documented. Therefore, whether the drowning accidents were related to rip currents could not be precisely determined. However, as claimed by the witnesses of the accidents, most of the victims were carried away from the shore by the currents (Hamsan and Ramli 2020). Coupled with panic attacks and poor swimming skills, the rips are believed to be one of the major causes of the increment of drowning-related fatalities.

Major factors that can be considered in determining the probability of rip currents occurring on beaches include the number of rip-related drowning accidents and the morphodynamic beach state (Hamsan and Ramli 2020). Theoretically, beach states are divided into three types which are known as reflective, intermediate, and dissipative. It is agreed

that the formation of rip currents can be found predominantly at beaches with intermediate beach state. For instance, out of five beaches along the Pahang coastline, three beaches known as Balok Beach, Batu Hitam Beach, and Sepat Beach are known to have an intermediate beach state. Thus, these beaches have been observed to possess higher chances for rip current hazards to occur. With a high number of drowning victims recorded, the existence of the rips along the stated beaches is inarguable.

As for now, most studies related to the rip current phenomenon primarily focus on the physical aspects of the rips. Those studies examine the rips' formation and implications as well as solutions to the rip currents (Carey and Rogers 2005; Short 2007). Many studies on the public perceptions of rip currents have been conducted in other countries such as the United Kingdom, the USA, Costa Rica, and Brazil (Brannstrom et al. 2015; Woodward et al. 2015; Fallon et al. 2017; Llopis et al. 2018; Silva-Cavalcanti et al. 2020). However, such studies are rarely found within the Malaysian context. As one of the countries that are fully surrounded by coastlines, enhancing studies on coastal-related fields, particularly regarding the rips, must encompass both physical and social sciences aspects.

The tourism industry is announced as the third-largest contributor to Malaysia's GDP (approximately 5.9%) (Hirschmann 2020). Statistics showed that the percentage of local tourists is rising to 8.5% from 2016 to 2017 (Department of Statistics Malaysia 2018). During the COVID-19 pandemic, it is projected that Malaysia's domestic tourism activities will improve by 30% for the second half of 2020 due to current government policy that restricts international tourists from crossing the Malaysian border (BERNAMA 2020). In addition, most businesses, particularly those involving tourism and hospitality industries, are allowed to operate to cater to local tourists. An incentive known as PENJANA Tourism Financing (PFT) was introduced with a RM 1 billion fund allocated as an effort to revitalize the tourism sector in Malaysia (New Straits Times 2020). A total of 180,000 flight tickets have been sold from the domestic travel promotions made by a local airline company last June (Malay Mail 2020). This current situation will naturally contribute to the high number of domestic tourists in Malaysia. With coastlines extending up to 8840 km, it is undeniable that beaches and islands have become major tourist attractions in Malaysia (Department of Statistics Malaysia 2019a). This indirectly increases the risk of rip-related hazards, particularly to the local tourists. Therefore, assessing Malaysians' behaviors, thoughts, and their understanding of natural beach hazards, namely the rips, can be very useful in minimizing the harmful consequences resulting from such hazards.

Several beach safety interventions have been introduced in Malaysia. Majlis Keselamatan Aktiviti Air (MKAA) was introduced in 2016 by the Ministry of Housing and Local Government Malaysia (Ministry of Housing and Local Government, n.d.). Mainly aimed at encouraging public awareness on the safety of water activities, few initiatives were established which include awareness campaign and exhibition, basic water activity safety module, article broadcasting, radio announcement, as well as related theory and practical exercises. MKAA also works on coordinating and integrating a compilation of drowning data. Concerning the issue related to unreported and undocumented drowning cases, this approach might be one of the potential solutions. Furthermore, Malaysia Civil Defence Force offers beach lifeguard services for several beaches all around Malaysia (Malaysia Civil Defence Force, n.d.). Introduced since 2003, approximately 13 beaches have been equipped with beach lifeguard towers. As a country that is surrounded by beaches and islands, it is undeniable that the number of lifeguard towers in Malaysia should be increased. However, the presence of lifeguard towers along beaches in Malaysia is seen as quite ineffective primarily due to the poor enforcement of the tower itself. It is observed that lifeguards are rarely present along

the beach and even at the tower. Strict enforcement should be immediately imposed so that the use of the existing beach safety facilities can be maximized in combating beach drowning incidents.

In performing social science-based studies, instruments used to assess the intended measurement must be reliable and validated. Radhakrishna (2007) highlighted that out of 748 research studies, 64% of them have applied questionnaires as data collection instruments but mostly failed to report procedures on the establishment of the questionnaires' validity and reliability. With that, it is indispensable to thoroughly follow and report the methods of assessing the validity and reliability of the questionnaires to enhance the effectiveness of data collection procedures.

As an example, the levels of public understanding of rip currents and beach safety of UK beaches were assessed (Woodward et al. 2015). With 407 respondents, the users of four beaches namely Croyde, Constantine Bay, Perranporth, and Chapel Porth were observed to possess poor knowledge of rip currents except for those who have experienced the rips themselves and those that have been previously exposed to related education. Meanwhile, the respondents were seen to have a good understanding of the connotation of the beach safety flags. Moreover, Sherker et al. (2010) conducted a study on beliefs and behaviors of beachgoers in relation to the beach flags and rip currents at New South Wales (NSW), Sydney. The results demonstrated that flags attracted parents and carers of children as the beachgoers with children tend to swim between the flags.

Beach users' understanding of a rip current warning sign was also evaluated at some heavily visited public beaches in Texas (Brannstrom et al. 2015). Imposing rip-related warning signs along the beaches have been part of the national education campaign named 'Break the Grip of the Rip!' (Houser et al. 2017). This initiative was developed in 2004 through the cooperation of the Rip Current Task Force, National Weather Service (NWS), and Sea Grant. A survey on the effectiveness of rip current warning signs was performed whereby 392 beach users have been surveyed from three different beaches, namely Galveston, Port Aransas, and Corpus Christi. This study shows that the warning sign of rip currents can successfully educate beach users on how to escape when dealing with the rips but is ineffective in guiding beach users to identify the rip currents while at the beach. A study that determines the rip current knowledge of Miami Beach's beachgoers was also conducted with 203 respondents (Fallon et al. 2017). It concluded that the frequency of beach users' exposure to the beach environment, maturity, and nativity are among the major contributors to the high level of rip current knowledge at Miami Beach.

This study may serve as a preliminary guide to introduce appropriate measures to educate Malaysian beach users on basic beach safety and rip current knowledge, while simultaneously minimizing the occurrence of drowning accidents in Malaysia. Through this study, a compilation of meaningful information related to public perception on beach safety and rip currents can be made. With that, effective educational frameworks related to beach safety and rip currents for the public can be produced. As an example, interactive infographics, information boards, and public facilities along the beach can be designed according to the needs of the public users. In fact, this study fills a gap in the available literature since few published social science-based studies are investigating the level of public understanding on beach safety and rip currents specifically in Malaysia. Therefore, this study aims to assess the level of public knowledge of rip currents and beach safety in Kuantan, Pahang.

2 Materials and methods

2.1 Study site

Sampling regime was at Teluk Cempedak Recreational Beach ($3^{\circ}48'43.50''$ N, $103^{\circ}22'21.41''$ E), one of the most frequently visited Malaysian beaches in Kuantan, Pahang (Fig. 1). Teluk Cempedak Beach is recognized as a pocket beach that is located between two headlands, namely Tanjung Pelindung Tengah and Tanjung Tembeling (Seng and Nor Hisyam 2009). Physically, Teluk Cempedak Beach is narrower and steeper compared to other popular beaches in Kuantan, Pahang with approximately 57.3 m of beach width and 3.28° beach slope (Hamsan, Mustapa, and Ramli 2019). Teluk Cempedak Beach has been enormously developed as one of the most visited places for public recreation and tourism activities in Pahang. However, fatalities due to drowning accidents at Teluk Cempedak Beach is higher than the other beaches. The absence of rip current warning signs along the bay proves the need to increase public understanding of rip currents and beach safety. Available beach safety signage and facilities at Teluk Cempedak Beach are illustrated in Fig. 2.

2.2 Study design and instrument

The survey instrument is an adaptation from similar studies conducted in New South Wales and Spain (Basterretxea-iribar et al. 2018; Sherker et al. 2010). The questionnaire comprised 31 questions divided into five sections: (1) socio-demographic background, (2)

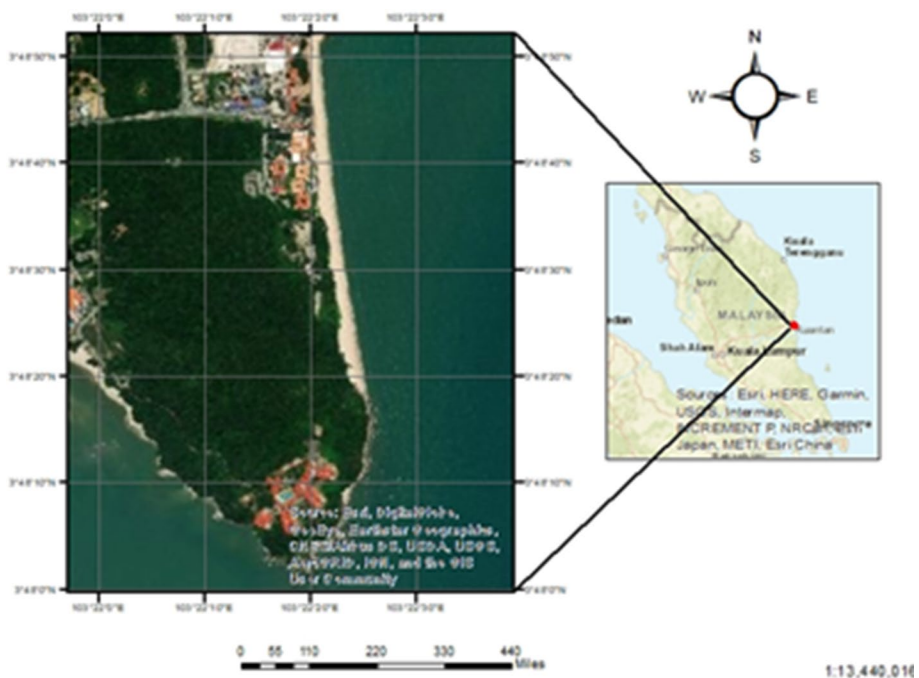


Fig. 1 Study area (Teluk Cempedak Beach) which is located at Kuantan district



Fig. 2 Available beach safety signage and facilities such as beach flags, a lifeguard tower, and a basic beach safety board at Teluk Cempedak Beach. No rips-related information board can be found

frequency of visiting the beach, (3) beach safety knowledge, (4) swimming ability, and (5) rip current knowledge. This questionnaire was first translated into the Malay language given the cultural, ethnic, and social differences between Eastern and Western cultures, and it is postulated to function differently in Malaysia. The instrument was then validated through face and content validity. The translation and validation process were done by an expert committee consisting of academicians that are specialized in marine sciences and social sciences from the International Islamic University Malaysia.

IUUM Research Ethics Committee (IREC) approved our study protocol, procedures, information sheet, and consent statement (IREC 2020–123). Participants who gave consent to willingly participate in the survey would be directed to complete the questionnaire.

2.3 Recruitment procedures and statistical analysis

Data collection was performed through a cross-sectional survey from August 2019 to November 2019. The respondents were recruited via convenient sampling. Prior to the survey, approval from Kuantan Municipal Council (MPK) was obtained to organize the awareness program on water activity safety in conjunction with Kuantan Fire and Rescue Department (JBPM). During the event, Malaysian respondents of different genders and a range of ages were approached. A self-guided face-to-face survey was performed after the respondents agreed to participate in the survey. It took approximately 10–15 min for the respondents to complete the questionnaire.

The collected data were analyzed using SPSS version 23. Descriptive analysis which primarily focused on frequencies and percentages was performed. In addition, Pearson correlation analyses were also performed.

3 Results and discussion

3.1 Validity of the questionnaire

The calculated content validity ratio (CVR) values are tabulated in Table 1. In terms of the relevancy of the questionnaire's items, all items were considered as relevant as most of the items scored 0.6–1. Similarly, all items were found to be clear and not ambiguous except for Question 17 and Question 29. The panel of experts agreed that the item in Question 17 requires further revision. Based on the comments received, the sentences used in this question were complicated and may lead to confusion among the respondents. These findings coincide with the observation made during the pilot study whereby most of the respondents faced difficulties in understanding and answering this question. Besides, the attached photographs for this question also needed revision due to their obscurities. The angle of the photographs should be wider to provide respondents with a clearer view. For Question 29, most of the experts agreed that this item was clear but still needs revision. This item was said to be one of the high-level questions that certain respondents may find difficult to answer. Based on the observations made, this question was found to be quite technical, as some respondents indeed have difficulty answering it. As the question only offered two possible answers, the experts suggest such options be diversified. Overall, the CVR calculated values and the comments provided by the panel of experts can be utilized as a reference to produce an improved version of the questionnaire.

3.2 Demographic information of the respondents

Table 2 summarized the demographic background of the respondents. A total of 60 beachgoers were interviewed with 66.7% and 33.3% being male and female, respectively. The respondents' ages were grouped into four groups which include 18–29 years old, 30–39 years old, 40–49 years old, and above 50 years old. 12 beachgoers surveyed

Table 1 CVR values for the questionnaire items in terms of their relevance, clarity, simplicity, and ambiguity of the items

Question No.	Components			
	Relevance	Clarity	Simplicity	Ambiguity
Q14	1	1	0.6	1
Q15	0.6	0.6	1	0.2
Q16	1	0.6	1	0.6
Q17	0.2	–1*	–0.6*	–0.6*
Q18	0.2	0.2	0.2	0.6
Q19	0.6	0.6	0.6	0.6
Q20	1	0.6	0.2	0.2
Q24	0.6	0.2	1	1
Q25	0.6	0.6	1	0.6
Q26	0.6	1	1	1
Q27	1	1	1	1
Q28	1	0.6	0.2	0.6
Q29	0.6	–0.2*	0.2	0.6

Values with an asterisk (*) indicate unacceptable CVR values

Table 2 Demographic information of the respondents in terms of their age groups, gender, presence of children, and locality

Label	Categories	Number of respondents, <i>n</i>	Percentage (%)
Age	18–29	12	20
	30–39	16	26.7
	40–49	16	26.7
	> 50	16	26.7
Gender	Male	40	66.7
	Female	20	33.3
At beach with children	Yes	26	43.3
	No	34	56.7
Locality	Yes	32	53.3
	No	28	46.7

belong to the first group, while the other three groups consisted of the same number of respondents, 16 beachgoers each. Overall, approximately 43% of them brought kids along while visiting the beach. The interviewed respondents were observed to come from different regions whereby only 53.3% were categorized as locals of Kuantan. Meanwhile, some of them come from other states such as Kuala Lumpur, Kelantan, Johor, Selangor, and Penang.

3.3 Frequency of visiting the beach

It was indicated that more than half of the interviewed beachgoers had frequently visited Teluk Cempedak Beach (Table 3). Approximately 91% of the beachgoers agreed to revisit Teluk Cempedak Beach. Specifically, in the study area, less than 40% of the beachgoers came to Teluk Cempedak Beach for swimming activities. Throughout all kinds of holidays, the weekends were the most preferred period for the beachgoers to visit the beach. Factors such as being safe, near, and accessible were among the major reasons that have highly encouraged beachgoers to visit this beach (Fig. 3). Apart from that, approximately 45% of the beachgoers have experience visiting non-patrolled beaches. However, due to the non-patrolled, unsafe environment and unsuitable wave conditions, 55% of the beachgoers refused to visit the non-patrolled beaches.

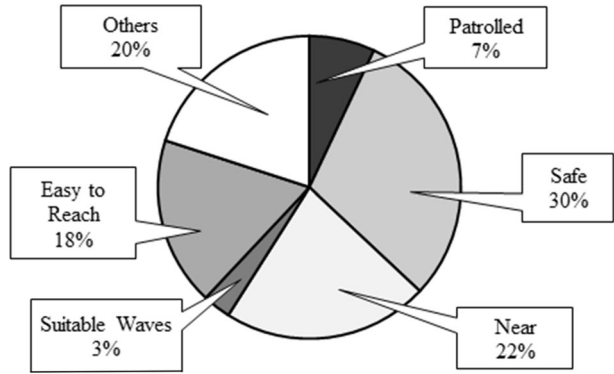
3.4 Swimming ability

This section was divided into two parts, which include the factors that influence the respondents' decisions of whether to visit the beach and the swimming abilities of the

Table 3 Descriptive data on the frequency of visit to the Teluk Cempedak Beach

Category	Items	Number of respondents, <i>n</i>	Percentage (%)
Frequency of beach visit	Once	7	11.7
	2–5 times	19	31.7
	> 5 times	34	56.7

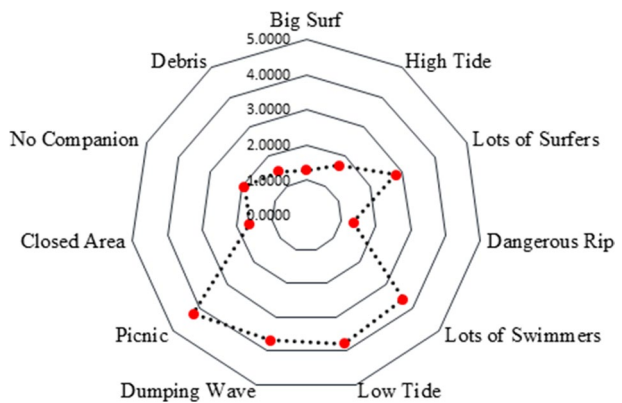
Fig. 3 Percentage fractions on factors which encourage the respondents to visit the Teluk Cempedak Beach



respondents. In the former part, factors such as being suited for picnics, the existence of dumping waves, low tide conditions, and availability of many swimmers around the beach strongly encouraged the respondents to visit the beach (Fig. 4). Meanwhile, factors like the existence of dangerous rips and big surf, availability of many surfers, high tide conditions, high abundance of debris, closed beach area, and the absence of companions have hindered the attendance of beachgoers.

For the latter part, it was found that both the probability of respondents drowning when swimming at the beach and their ability to escape from the rips were at moderate levels (Fig. 5a, b). In terms of swimming distance, over 60% of the respondents can be categorized as poor swimmers as most of them can only swim less than 25 m (Fig. 6). Meanwhile, approximately 8% of the respondents could swim over 100 m non-stop and can be considered excellent swimmers. Poor swimming abilities of the respondents might have contributed to the low level of rip current knowledge. Good and professional swimmers may have a higher ability to recognize the rip current phenomenon and subsequently know how to escape from the rips. Most studies depicted that better swimmers were found to know more about the rip currents (Williamson et al. 2012; Drozdowski et al. 2015; Fallon et al. 2017).

Fig. 4 Spider web chart that shows the factors which influence the respondents’ decisions whether to visit or not to visit the beach



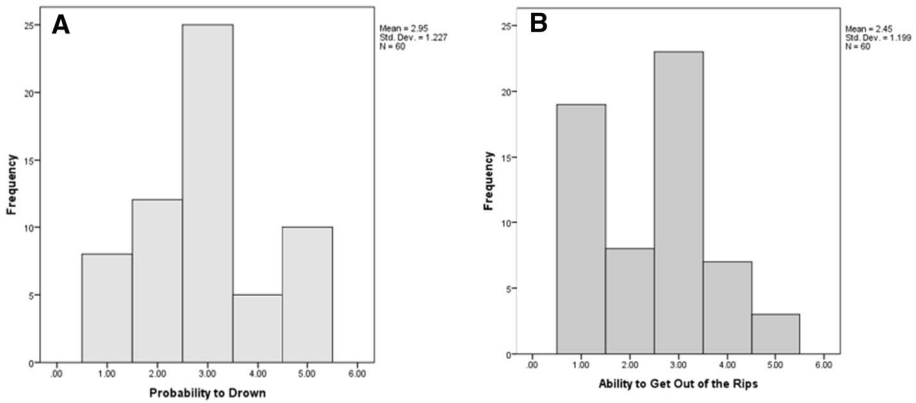
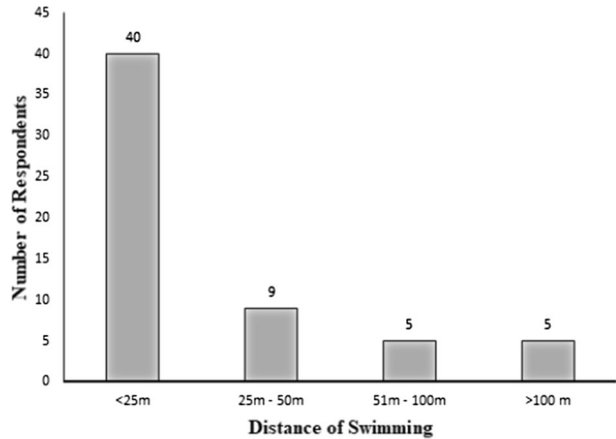


Fig. 5 Histogram that shows the probability of the respondents to drown (a) Histogram that shows the ability of the respondents to escape from the rips (b)

Fig. 6 Bar graph that reflects the swimming ability of the respondents in terms of swimming distance



3.5 Beach safety knowledge

More than 80% of the respondents were aware of the function of the lifeguard tower at the beach (Fig. 7a). Regarding the Yellow–Red flag, only 45% of the respondents gave the correct answer (Fig. 7b). Meanwhile, for the Red flag, almost all respondents answered correctly with a percentage of 96.7% (Fig. 7c). Approximately 86% of the respondents agreed that the primary purpose of placing the flags was to show that the particular area was unsafe for swimming activities. Such percentages showed that the respondents have a satisfactory level of knowledge for both the Yellow–Red flag and the Red flag. Due to the high hazard rating of Teluk Cempedak Beach, together with its popularity as a tourist destination, lifeguard patrols around the beach areas might be extensive. This could have contributed to the high percentage of satisfactory knowledge levels of beach-related flags. A similar scenario can be observed at the beaches of the United Kingdom (Woodward et al. 2015).

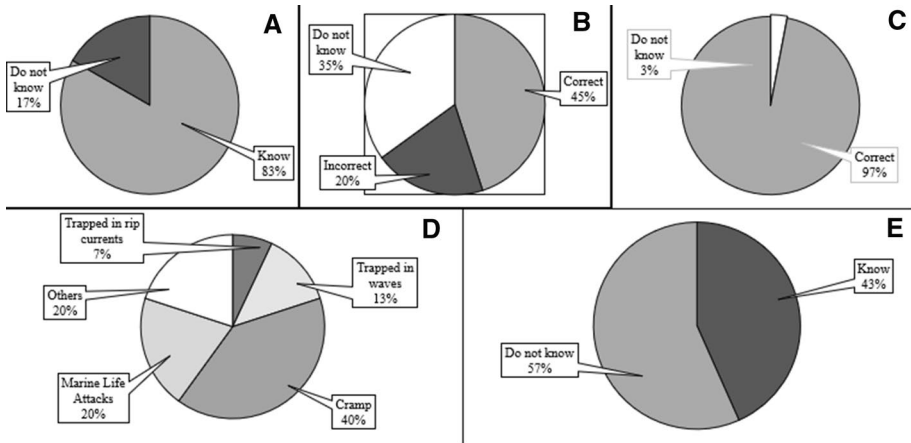


Fig. 7 The percentage of respondents who are aware of the function of the lifeguard tower (a) The percentage of respondents who are aware of the function of the Yellow-Red flag (b) The percentage of respondents who are aware of the function of the Red flag (c) Typical problems faced by the respondents (d) The percentage of respondents who are aware of the existence of the rip currents (e)

Three different cards that illustrated the beach conditions were shown to each respondent. Those cards contained pictures of beaches with or without flags and beaches with or without waves. Most of the respondents (approximately 33%) have wrongly interpreted the meaning of all cards. Only 18.3% of the respondents could give correct answers for all cards.

Besides, 25% of the beachgoers were found to have faced problems while doing recreational activities at the beach. Cramps and marine life attacks were among the major problems (Fig. 7d). Only 6.67% of the respondents claim that they have encountered rip current problems. These findings were found to be contradictory with a study performed by Basterretxea-iribar et al. (2018) whereby major problems faced by the beachgoers of Basque Country were mostly related to the waves and the rip currents. The fact that rip currents occupy a low percentage of the major problems faced by the Teluk Cempedak beach visitors might be related to the inability of the respondents to recognize the existence of rip currents. Therefore, whether they have encountered the rip current phenomenon remains unknown.

3.6 Rip current knowledge

About 83% of the respondents were aware of the existence of currents, while only 26% of the respondents were aware of the existence of rip currents (Fig. 7e). Most of the respondents failed to give the general definition of currents, whereas only 20% of the respondents could define currents as the velocity of water (Fig. 8). The majority of the respondents selected incorrect answers when asked to choose a swimming direction when dragged by currents, whereas only 25% gave the correct answer, to swim parallel to the flow of currents (Fig. 9).

Two photographs were shown to each respondent to which their ability to recognize the rip current existence was analyzed. In both photographs, if the respondents pick A or/and B option as the safest places for swimming activities, it was assumed that the respondents had

Fig. 8 Bar graph that shows the respondents' understanding of the meaning of currents

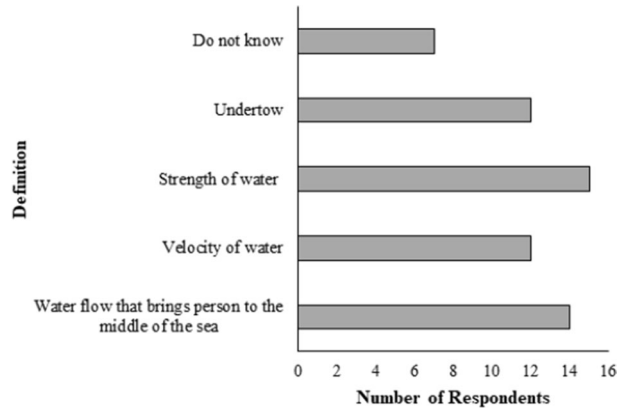
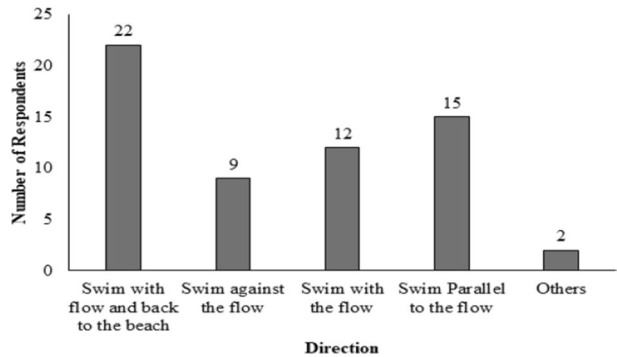


Fig. 9 Bar graph that shows the respondents' decisions in terms of swimming direction when being dragged by rip currents



a high ability in recognizing the rips. In other words, the option C of the questionnaire's item represents the area with the existence of rip currents. For Photograph A, over 50% of the respondents failed to recognize the rip current. Meanwhile, Photograph B shows that half of the respondents could recognize the rip currents, while the other half were unable to.

As most of the respondents were unaware of the existence of the rip currents, most of them could not recognize the rip currents shown in the photographs. These findings aligned with other studies that highlighted beachgoers' difficulties in identifying rip currents (Ballantyne, Carr and Hughes, n.d.; Brannstrom et al. 2015; Sherker et al. 2010). In some research, although the respondents claimed to know what rip currents are, most of the respondents still failed to recognize them (Ballantyne et al., n.d.; Brannstrom et al. 2015; Caldwell, Houser and Meyer-Arendt 2013).

Despite the small sample size, the results obtained were found to be comparable to other studies that applied almost similar questionnaire items. Findings by Sherker et al. (2010) reflected the respondents' poor levels of rip current knowledge. Over 50% of the respondents decided to swim in the rips. Although 33.7% of them claimed to be able to identify the rips, most of them indicated the location of the rips inaccurately. In addition, results from Basterretxea-iribar et al. (2018) also highlighted the low level of rip current understanding among the respondents. Out of 364 beachgoers, only 25 of them could recognize the rips' existence, while 18 of them could point out the correct direction to escape from the rips.

The results from Pearson correlation analyses are presented in Table 4. From the analyses, only several variables were found as correlated with beach safety and rip current knowledge. Variables such as age, frequency of visiting the beach, and frequency of swimming were all moderately correlated ($r = -0.311$ – 0.262). Both age and frequency of swimming were positively correlated with the definition of currents and the awareness of the currents' existence. It was found that the knowledge of the older respondents (> 30 years old) regarding currents was higher compared to the younger generation. In terms of swimming ability, the respondents that claimed to be good swimmers showed a satisfactory level of understanding toward rip currents.

4 Conclusion

A questionnaire was distributed to 60 beachgoers at Teluk Cempedak Beach to examine the level of public understanding of rip currents and beach safety knowledge. Several conclusions were deduced based on the preliminary study and are stated as follows:

The level of rip current knowledge among Teluk Cempedak Beach users was poor, with only 20% ($n = 12$) of them being able to accurately define the rip current.

Conversely, the beach users were found to possess higher beach safety knowledge whereby 45% and 97% of them could give the correct meaning of the beach safety flags.

The results obtained did not consider the whole picture of the intended measurement as this research was still under the preliminary phase. However, the process was observed to have a potential in providing meaningful information and consequently greatly contributing to the development of beach safety intervention as well as education in Malaysia. Due to the low level of rip current understanding, rip-related knowledge should be further emphasized as an additional topic in beach safety educational modules in order to familiarize the public with the rip current phenomenon. Furthermore, based on the findings, the effort of educating the public on beach safety and rip currents can be initiated with the younger generation as the target group. Finally, swimming lessons can be introduced as part of the beach safety educational module to enhance the swimming skills among Malaysians.

Therefore, an extension of this research should be made in the future in order to achieve the objectives. Further revision as well as modification of the questionnaire will be made. More consultation with experts should be performed throughout the process of refining the questionnaire. A larger sample size will be surveyed to obtain a complete view on public understanding of beach safety and rip currents. Furthermore, future-related studies intend

Table 4 Pearson correlation coefficient

Parameter	Function of lifeguard tower	Awareness on current existence	Awareness of rip current existence	Current definition
Age	-0.311* (Medium negative C)	-0.091	-0.052	0.262* (Small C)
Frequency Visit the Beach	0.032	-0.032	-0.257* (Small C)	0.042
Frequency of Swimming	0.013	0.254* (Small C)	0.191	0.253

*Correlation is significant at the 0.05 level (2-tailed)

to focus on different beach topography that would indicate higher rip current occurrence. This may help in improving the beach safety facilities along the beach. Through the findings, beach safety awareness mobile applications can be developed for public users. Such applications might help beach users by providing real-time information on the current situation or possible hazards while being at the beach. This can indirectly educate beachgoers and prevent unwanted accidents such as beach drownings from happening.

Supplementary information The online version contains supplementary material available at (<https://doi.org/10.1007/s11069-021-04613-z>).

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