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What affects the risk of recreational craft users? – A literature review

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Annually, many incidents and accidents with recreational craft are occurring. They result in fatalities, major injuries, and severe material damages. However, there is no full overview of how many incidents and accidents occur and the factors leading to these accidents. The Norwegian Maritime Authority (NMA) together with key stakeholders identified the need for more comprehensive collection and analysis of incidents, accidents and associated risk factors. To address the issue an integrated data platform for recreational craft accidents, including a risk module to analyse and predict areas with high accident rates, is under development.
This paper summarizes the preliminary findings from a literature study on the risk factors associated with accidents and their outcomes with recreational craft at sea. In total 59 articles were reviewed published in the period between 2001 and 2021, of which 35 were describing relevant risk factors. These articles cover a range of statistics and accidents reports on recreational craft. The most often mentioned risk factors relate to wear of personal flotation devices, craft type and length, and weather conditions. The most detailed risk factors described in the literature are related to the recreational craft users involved in accidents. The results of this literature study will give input to the development of the data platform on recreational craft accidents in Norway.

Keywords: Recreational boating, recreational craft safety, risk factors, accidental factor analysis

1. Introduction

People of all ages and backgrounds use recreational craft for leisure activities in Norway. Every year, more than 2.2 million Norwegians spend time on board recreational craft at sea. NMA estimates that there are approximately 1 million recreational craft in Norway (Norwegian Maritime Authority 2019). On average 31 people die every year in Norway using recreational craft (Norwegian Maritime Authority 2021). There is a declining trend over the last decade, with 26 fatalities in 2021. The information collected about these fatal accidents includes, for example, date of the accident, location, and type of accident. Personal information about the deceased, such as, the age, sex, alcohol consumption and use of personal floating device (PFD) is also collected. However, this information and its level of detail do not sufficiently provide knowledge to assess detailed and targeted measures to effectively prevent recreational craft accidents.

On this background the plan of action by the (Norwegian Maritime Authority 2019), in collaboration with other governmental organizations and NGOs, identified that one of the main actions to reach the Norwegian governments vision of "zero fatalities" through recreational craft activity was to increase the level of knowledge concerning incidents and accidents when recreational craft are involved. The plan of action (Norwegian Maritime Authority 2019) was made on the basis of the Norwegian governmental white paper no. 33 (2016-2017), the national transportation plan 2018-2029 that stated the goal of no incidents with serious injuries or fatalities through use of recreational craft. The white paper refers to previous experiences from road safety and the mapping of recreational craft accidents carried out by the (Accident Investigation Board Norway 2019). This whitepaper (Accident Investigation Board Norway 2019) highlights the potential for improving the Norwegian Maritime Authority's basis for keeping annual statistics on fatal recreational craft accidents and also identifies the possibility of using and combining multiple data sources to gain a more comprehensive foundation for these statistics.

With this background, the main stakeholders within recreational craft activities in Norway conduct a three-year long research project with the aim of developing a digital supported platform to provide collaboration across these stakeholders, the "integrated digital platform for recreational craft" project. As part of this project one of the goals is to develop a risk model describing qualitatively and quantitatively the factors that affect risk when using

recreational craft in Norway. However, there is no comprehensive study of risk factors affecting the use of recreational craft available. Thus, this paper summarizes the findings of a literature study that aimed to identify risk factors affecting recreational craft. The risk factors will be used to inform the risk model in the digital platform for recreational craft project and to validate the findings that were obtained in the project so far. The next section presents the scope of the literature study and the method. Section 3 summarizes the results. Section 4 discusses the results and their validity. The last section summarizes the work and outlines further work.

2. Definitions and method

Risk in this project is described as a combination of frequency and consequences of a given accident per annual activity level related to that accident. The risk is modelled through influence diagrams for the different risk categories, using risk factors. A risk [influencing] factor is "an aspect (event or condition) of a system or an activity that affects the risk level of this system or activity" (Øien 2001). Risk factors can affect the frequency or likelihood, the consequences or both of an accident. There are three major categories of risk factors, technical and operational (i), regulatory activities (controls through governmental and private organizations, ii), and rules and requirements (iii), c.f., Figure 1.

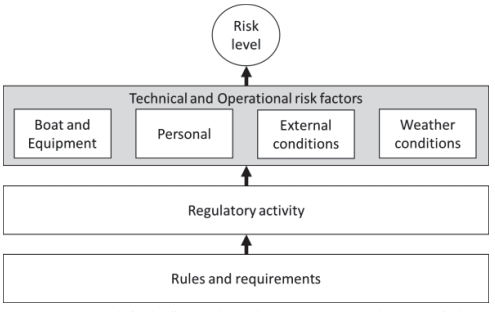

Figure 1 Risk influencing factors categories used in this article

Relevant accidents for the digital platform for recreational craft project are capsizing, collision, fall in the sea from a craft or pier, when entering or exiting a craft, fire, flooding of the craft, grounding, injuries directly related to craft use (excludes, e.g., fishing), loss of or limited propulsion power, person overboard. Other accidents, where it is not known what the accident cause was, i.e., how a person ended in the water.

A recreational craft (Norwegian: *fritidsfartøy*) considers every floating equipment that is designed for and able to move on water with a maximal length up to 24 m and that is used for non-commercial activities (Norwegian Ministry for Fisheries and Economy 2015). For this study this includes motorboats (open or with cabin), sailing boats (open or with cabin), kayaks, canoes, rafts, (wind) surf boards, stand-up paddle boards, and personal watercraft (PWC). PWC are sit-on or stand-on craft opposed to boats where the user is in the vessel. Surf boards are generally not considered recreational craft since they are passively driven by riding on waves, contrary to wind surf boards that are wind driven.

2.1. Literature search

The literature study was conducted in Autumn 2021. The Scopus literature database was searched for relevant publications for this purpose the following key words were used, where "AND" and "OR" are Boolean operators to connect the search terms appropriately:

- (*Leisure* OR *Pleasure* OR *Recreational*)
- AND (*Boat* OR *Craft* OR *Boating*)
- AND (*Accident* OR *accident analysis* OR (*Risk analysis*) OR (*Safety analysis*) OR (*Risk influencing factor*) OR (*RIF)* OR (*Safety model*) OR (*Risk model*) OR (*Safety)* OR (*Risk)*))

To limit the results to relevant only publications of the type: articles, conference papers, book chapter, reviews, in English language were considered. The identified publications were exported and analysed in six steps. Step 1, eliminate duplicated references. Step 2, eliminate irrelevant publications through studying abstract, title, and keywords that are not associated with risk of recreational craft. Step 3, find the full text publications and eliminate articles where the full text is not accessible. Step 4, review the articles and eliminate articles that do not cover recreational craft or RIF. Step 5, record the relevant findings in a shared database. This includes, a summary of the articles' objectives and contributions, type of study, data sources, suitability for modelling, and identified risk factors in the categories:

- Recreational craft and onboard equipment
- Person
- External conditions (except weather conditions)
- Weather conditions
- Regulatory activity or requirements, regulations
- Other

The risk factors categories used (Steps 5 and 6) are based on a previous analysis conducted with stakeholder engagement in the project. The risk factors identified in the publications were noted as summarized in more generic forms to avoid overspecification.

3. Results

Through the search in Scopus 391 articles were identified that fit the search parameters. The screening process is summarized in Figure 2.

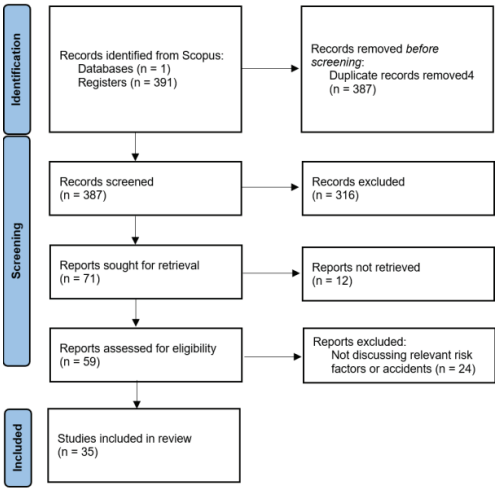

Figure 2 Flow diagram summarizing the review process in this paper

The remainder of this article will discuss the finding from the 35 relevant articles. 13 articles discussed risk factors that are relevant for the full accident modelling, i.e., that affect frequency of accidents and consequence of recreational craft accidents. Eight of the articles describe risk factors that mainly affect the frequency of recreational craft accidents. 14 articles discuss risk factors that mainly affect the consequence of recreational craft accidents.

Figure 3 summarizes the types of recreational craft that are addressed in the review literature. Most of the publications cover several types, most of them cover motorboats (15), and sailing boats (10). Eight address all types of craft, as defined in the introduction. Some of the articles focus on very specific craft types, such as, the interaction between ferries and recreational craft (motorboats, 2), house boats (2), and leisure fishing vessels (1). The craft types that are covered to a low degree are often covered in connection with other recreational craft types, such as motorboats and sailing boats. Water skiing is not a recreational craft per se but were mentioned in connection with the use of motorboats. Similarly, surf boards are not a recreational craft, unless they use a sail. Therefore, only publications which cover sail surf boards were considered further.

Regarding data sources the reviewed literature relies mainly on accident data reports and public statistics, c.f., Figure 4. A source used often is the US Coast Guard Boating Accident Report database, hence this one was listed separately. The accident reports and statistics in the publications mainly rely on data of official national organizations. This data is collected to identify safety measures (e.g. regulations, product safety, training, awareness campaigns). Liability and finding out who was at fault leading to the accident is of secondary concern. Some of the accident reports in the publications are also provided by insurance companies, these often have the goal to establish liability and identify who is responsible for the accident. Several publications combine accident statistics with interviews or surveys. Police reports are listed once, in this case the article combined several sources explicitly mentioning police reports, along with medical reports and accident reports (Bugeja et al. 2014).

Figure 5 summarizes the types of accident that are addressed by the reviewed publications. Due to the broad spectrum of publication reviewed, the covered accident types in the literature vary in the level of detail. Some may be classified as consequences, for example hypothermia, asphyxiation, etc.) or events leading to an accident (Fall overboard).

As a convention for the remainder of this article capitalized words indicate risk factors, risk factors categories are marked through quotation marks.

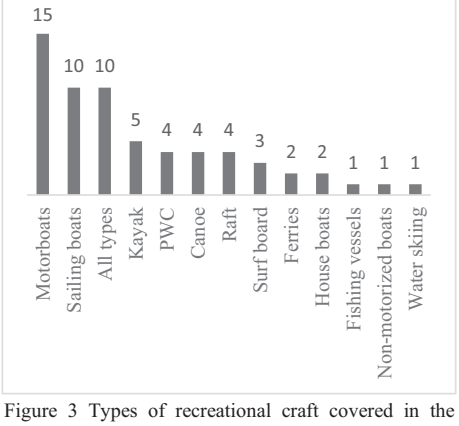

Figure 3 Types of recreational craft covered in the reviewer literature. Some publications address several recreational craft categories.

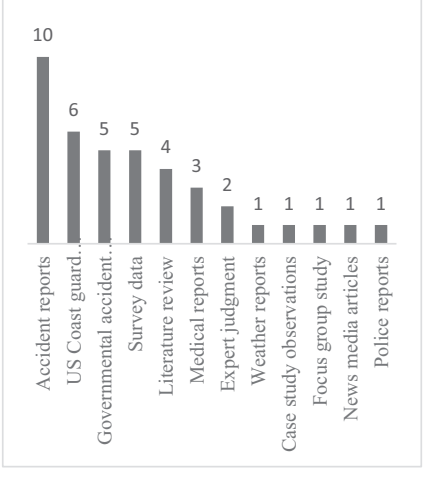

Figure 4 Data sources used in the reviewed publications. Some publications made use of several sources.

3.1. Risk influencing factors in the literature for full risk modelling

The 13 articles in this category are (Atlas et al. 2016), (Driscoll, Harrison, and Steenkamp 2004), (Heggie 2018), (Lenorovitz, Karnes, and Haygood 2020), (Mangione et al. 2008), (McCarthy and Talley 2001), (McKnight et al. 2007), (Otamendi and González De Vega 2013), (Ryan et al. 2016), (Smith et al. 2001), (Swett et al. 2011), (Viauroux and Gungor 2016), and (Willcox-Pidgeon et al. 2019).

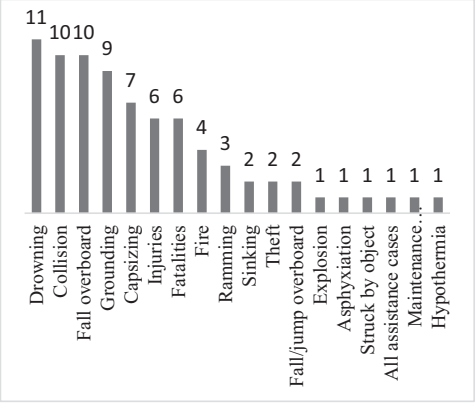

Figure 5 Types of accidents covered in the reviewed literature. Some publications cover several types of accidents.

Table 1 shows the identified risk factors for the publications that were categorized as being suitable for full risk modelling. The number of publications that mentioned a particular risk factor is indicated in brackets. Regarding the category "recreational craft and onboard equipment", the Craft type and Craft length seem to be highly relevant risk factors. The risk factor Activity, which was mentioned in two publications and several times more in the other categories refers to the type of activity that are carried out, stand still (for example fishing), cruising or manoeuvring, or also whitewater kayaking, rafting or canoeing vs. sea, flatwater kayaking, canoeing, or rafting.

Regarding the category "person", PFD use, Alcohol use (also mentioned were Alcohol level, and Substance use), Age, Experience (with recreational craft), Sex, and Formal competence were mentioned the most often. One study investigated in particular the risk factors related to Human error and Improper boating behaviour (McKnight et al. 2007), several other publications pointed out related risk factors, such as, Careless or reckless operation, Improper lookout, and Speeding.

Regarding "external conditions", Time of day, Day of the week, Location, Type of water, and Traffic density were mentioned most often. The Distance to marine or city (Willcox-Pidgeon et al. 2019), Distance to hospital, and Multidisciplinary competency in hospital (Atlas et al. 2016), were pointed out to be affecting severity of consequences significantly through the correlation to response time. Regarding "weather conditions", most often mentioned are generic Weather conditions, without detailing these further. However, Wind and Waves are separately mentioned several times as affecting risk.

Table 1 Risk factors identified in the literature labelled as full risk modelling. Times mentioned in brackets () by the 13 reviewed articles.

Recreational craft and onboard equipment	**Person**	**External conditions**	**Weather conditions**	**Regulatory activity or requirements, regulations**
Craft type (4), Craft length (4), Craft speed (2), Activity (2), Carbon monoxide formation (1), Dead-man switch for the driver (1), Equipment or machinery failure (1), Failure in ventilation (1), Hull failure (1), Handle for passenger (1), Horsepower (1), Improper loading or overloading (1), Lack of or improper lights (1), Manoeuvrability of PWC (1), Suitability of PFD (1), Warning labels adequacy (1)	PFD use (8), Alcohol use (6), Age (5), Experience (5), Passengers (4), Sex (4), Formal competence (3), Craft rented (2), Human error (2), Improper lookout (2), Speeding (2), Position on craft (2), Blood alcohol level (1), Careless or reckless operation (1), Correct use of PWC (1), Formal training (1), Improper anchoring (1), Passenger behaviour (1), Substance use (1), Use of wet suit (1), Violating rules or regulations (1)	Time of day (3), Day of week (2), Location (2), Traffic density (2), Type of water (2), Distance to city or marina (1), Distance to hospital (1), Hazardous waters (1), Ignition of spilled fuel (1), Infrastructure in waterway (1), Multidisciplinary competency in hospital (1), Number of craft involved (1), Season (1), Visitor status (1), Waterway condition (1)	Weather conditions (3), Waves (2), Wind (2), Air temperature (1), Fog (1), Storms (1), Visibility (1), Water current (1), Water level (1), Water temperature (1)	Warning or instructions requirements (2), Alcohol awareness campaigns (1), Penalty level for alcohol use (1)

Table 2 Risk factors identified in the literature labelled as frequency modelling. Times mentioned in brackets () by the eight reviewed articles.

Recreational craft and onboard equipment	**Person**	**External conditions**	**Weather conditions**	**Regulatory activity/ requirements, regulations**
Craft type (4), Navigational equipment (3), Activity (1), Craft length (1), Improper loading or overloading (1), Suitability of PFD (1), Living on boat (1)	Alcohol use (3), Experience (3), PFD use (3), Formal competence (2), Formal training (2), Age (1), Children on board (1), Familiarity with location (1), Hours of training (1), Income level (1), Nationality (1), Safety equipment use (1), Skill level (1), Substance use (1), Violating rules or regulations (1), Peer pressure to adhere to rules (1)	Location (3), Dangerous animals in water (1), Distance to shore (1), Navigational complexity (1), Number of registered craft (1), Month (1), Radio communication (1), Traffic density (1),	Waves (2), Weather condition (2), Wind (2), Visibility (1), Water quality (1), Water temperature (1)	Collision avoidance rules (1), Patrol officers per 1000 craft (1), Regulations for PFD use (1), Requirements navigational equipment (1)

Warning label requirements have been mentioned especially in connection with PWC to affect the risk level. Whereas the risk factors Alcohol awareness campaigns and Penalties for alcohol use are mentioned only once in the "regulatory requirements or activity and regulation" category. The latter is surprising given that eight publications mentioned Alcohol use and related risk factors. Looking at the data sources for the reviewed publications may explain this. Many publications rely on accident reports and statistics of official bodies. These databases do not contain information if people where targeted by campaigns, but they will contain information on alcohol use, etc. since these circumstances are routinely recorded.

3.2. Risk influencing factors in the literature for frequency modelling

Regarding the risk factors identified as mainly being suitable for frequency modelling, similar ones were identified as for full risk modelling, c.f., Table 2. The eight articles are (de Vos and Rautenbach 2019), (Franklin and Leggat 2012), (Gabe and Hite 2003), (Nævestad et al. 2018), (Pitman 2019), (Roberts, Nielsen, and Jaremin 2013), (Toman et al. 2020), and (Øvergård, Tannum, and Haavardtun 2020).

For the category "recreational craft and onboard equipment", the risk factors Craft type, and Navigational equipment were most often mentioned. Regarding risk factors in the category of "person": Alcohol use, Experience, PFD use are mentioned most often. In addition, Formal competence (i.e., boating license) and Formal training (i.e., participation in safety training) were mentioned two times. In how far these two risk factors are different or overlap needs to be determined.

Regarding "external conditions", Location (region or area of boating) was mentioned most often. The Location is associated with other risk factors, such as, Characteristics of the waterway, and Traffic density, which were not mentioned as often. One publication (Franklin and Leggat 2012), mentioned the risk factors Dangerous animals in the water, and Water quality itself, as a source of injuries. No other publications mentioned these risk factors.

Regarding the category "weather conditions", Weather condition in general was mentioned twice, as was Wind and Waves. Regarding the category "regulatory activity or requirements, regulations", Collision avoidance rules, Patrol officers per 1000 recreational craft, and Regulations for PFD use are mentioned.

3.3. Risk influencing factors in the literature for consequence modelling

Similar risk factors are mentioned for consequence modelling as for the previous two modelling types, c.f. Table 3. The following 14 publications were reviewed; (Bugeja et al. 2014), (Cassell and Newstead 2015), (Chalmers and Morrison 2003), (Cummings, Mueller, and Quan 2011), (Hudson, Ekman, and Svanström 2007), (Lapa, Turgut, and Turgut 2012), (Nathanson, Young, and Young 2015), (Neville and Folland 2009), (Otamendi and de Vega 2014), (Phillips et al. 2019), (Quistberg, Quan, et al. 2014), (Quistberg, Bennett, et al. 2014), (Rizzo et al. 2021), and (Spitzer et al. 2018).

Craft type (5), Craft length (4), Activity (2), Hull shape or design (2), and Sufficient number of PFD are the most mentioned risk factors in the category "recreational craft and onboard equipment". For risk factors in the category "person", PFD use (8), Age (6), Passengers (4), Physical training (3), Sex (3), Swimming ability (3), where the most mentioned once. Distance to shore (2), External help (2), Location (1), Time to initiate search and rescue (1), Time to treat injuries (1) are the risk factors mentioned in the category "external conditions". It can be seen, as could be expected for consequences, these risk factors all relate to receiving assistance or treatment in case of an accident. For the "weather conditions", Weather conditions (5), Wind (5), Water

temperature (3), Waves (2), Visibility (2) were the most mentioned risk factors. Regarding the category "Regulatory activity or requirements, regulations" three risk factors are mentioned in the reviewed literature; Regulations for PFD use (3), Education campaign about risks (1), Regulations for formal competence training and craft certification (1). Additionally, one publication (Rizzo et al. 2021) mentioned that the mechanism of a person ending up in the water is affecting the risk level. However, modelling the different accidents will include this risk factors automatically, therefore this is not listed.

Table 3 Risk factors identified in the literature labelled as consequence risk. Times mentioned in brackets () by the 14 reviewed articles.

Recreational craft and onboard equipment	**Person**	**External conditions**	**Weather conditions**	**Regulatory activity requirements, regulations**
Craft type (5), Craft length (4), Activity (2), Hull shape or design (2), Sufficient number of PFD (2), Craft certified (1), Distress signal equipment (1), Equipment design (wind surfing, etc., 1), First aid kit on board (1), Type of PFD (1)	PFD use (8), Age (6), Passengers (4), Physical training (3), Sex (3), Swimming ability (3), Alcohol use (2), Children on board (2), Experience (2), Perceived comfort of PFD (2), Personal medical history (2), Position on craft (2), Technique (2), Confidence in PFD (1), Formal competence (1), Knowledge of first aid (1), Perceived weather conditions (1), Rescue response by passengers (1), Safety equipment use (1), Speeding (1), Substance use (1)	Distance to shore (2), External help (2), Location (1), Time to initiate search and rescue (1), Time to treat injuries (1)	Weather conditions (5), Wind (5), Water temperature (3), Waves (2), Visibility (2), Air temperature (1), Surf (1), Water current (1)	Regulations for PFD use (3), Education campaign about risks (1), Regulations for formal competence training and craft certification (1)

4. Discussion

This article lists risk factors identified from the reviewed publications. The numbers provided are not a measure of importance of the risk factors or the most common accidents or accident causes, however, they could give an indication of importance. An in-depth study of the publications and evaluation of the relationships is necessary to determine the importance of each risk factors. The findings in this article are described qualitatively. The reviewed publications provide a more detailed picture of the circumstances the found risk factors interact with each other.

The literature study covers a large topical area, with many types of accidents. Each accident type has its own risk factors associated with them, i.e., falling off a PWC, being hit by the boom on a sailing boat, or grounding with a powerboat. Many risk factor being mentioned only once or twice are found in publications, which study certain accidents in detail. These risk factors should not be dismissed and should be considered and included for relevant accidents.

Regarding the quantitative relationships in the literature, these should be used with care, some described statistics may be only applicable for a certain location, region, or country. These local circumstances, regulations and culture should be considered when selecting relevant risk factors and the quantitative relationships between them.

The data sources used in the reviewed publications rely, in many cases, on public accident reports and statistics. The focus of these data sources is mainly on the operators and users of leisure craft and possible circumstances that affected them. Some of the accident reports are based on police reports, insurance data or reports from other private organizations, which mainly have the goal to establish liability. This may explain why so many "person"-risk factors are identified compared to the other categories. In addition, the official statistics and accident reports are often aiming at identifying safety measures, awareness campaigns or new regulations. Thus, they focus on human behaviour. The effectiveness of new measures is only covered to a limited extend in the literature.

One limitation with the study is that it only considered publications in English. Most publications originate from English speaking countries. Reports, statistics, and articles from national bodies in their respective native language may contain, for example, more data on the effectiveness of regulations, awareness campaigns, etc. Another challenge associated with language is that different countries use different terms in English for accident types, craft types, etc. This is already visible regarding the concept of a recreational craft, which is known also under synonyms, such as, leisure craft, leisure boat, pleasure craft, etc.

5. Conclusion and further work

This article summarizes the findings from a literature review on 35 relevant publications covering the topic of factors affecting the risk of recreational craft. The most mentioned risk factors in the literature are Craft type and Craft length, Activity with the craft (fishing, cruising, paddling etc.), PFD use, Age, Alcohol use, Experience, Passengers (and children) on board, Sex, Formal competence, Location, Weather conditions, Wind, Waves, and Water temperature. However, as discussed, this is only

indicative of their importance. The identified and mapped out risk factors can be used to inform risk models and thus provide a better basis for identifying safety measures and predicting needs for emergency response resources, such as, the digital platform for recreational craft is establishing.

Several challenges have been identified regarding data collection of recreational craft related risk factors. Firstly, accident statistics and reports are documented nationally and thus, information sharing is difficult because of language barriers and different terms being used. Therefore, data should be collected internationally, in a standardized way and shared accordingly. Secondly, accident reports and statistics focus on the recreational craft users, which may bias the identification of risk factors towards "person"-related risk factors.

Regarding the digital platform for recreational craft in Norway, the next steps are to use the identified risk factors to inform and validate the risk model. Especially the quantification is expected to benefit from the literature. The qualitative and associated quantitative relations still need to be developed.

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References

Accident Investigation Board Norway. 2019. “Mapping of Recreational Craft Accidents Main Report.”

Atlas, Ilan, Michael Jerdev, Johnny s. Younis, Mohanna Khateeb, Izhar b. Shlomo, and Adeeb Nicola. 2016. “Falling behind a Jet Ski: A Sad End to a Pleasure Ride.” *Trauma* 18 (1): 65–69. https://doi.org/10.1177/1460408615603387.

Bugeja, Lyndal, Erin Cassell, Lisa R. Brodie, and Simon J. Walter. 2014. “Effectiveness of the 2005 Compulsory Personal Flotation Device (PFD) Wearing Regulations in Reducing Drowning Deaths among Recreational Boaters in Victoria, Australia.” *Injury Prevention* 20 (6): 387–92. https://doi.org/10.1136/injuryprev-2014-041169.

Cassell, Erin, and Stuart Newstead. 2015. “Did Compulsory Wear Regulations Increase Personal Flotation Device (PFD) Use by Boaters in Small Power Recreational Vessels? A before-after Observational Study Conducted in Victoria, Australia.” *Injury Prevention* 21 (1): 15–22. https://doi.org/10.1136/injuryprev-2014-041170.

Chalmers, David J., and Luke Morrison. 2003. “Epidemiology of Non-Submersion Injuries in Aquatic Sporting and Recreational Activities.” *Sports Medicine* 33 (10): 745–70. https://doi.org/10.2165/00007256-200333100-00003.

Cummings, P., B. A. Mueller, and L. Quan. 2011. “Association between Wearing a Personal Floatation Device and Death by Drowning among Recreational Boaters: A Matched Cohort Analysis of United States Coast Guard Data.” *Injury Prevention* 17 (3): 156–59. https://doi.org/10.1136/ip.2010.028688.

Driscoll, T. R., J. A. Harrison, and M. Steenkamp. 2004. “Review of the Role of Alcohol in Drowning Associated with Recreational Aquatic Activity.” *Injury Prevention* 10 (2): 107–13. https://doi.org/10.1136/ip.2003.004390.

Franklin, Richard C., and Peter A. Leggat. 2012. “The Epidemiology of Injury in Canoeing, Kayaking and Rafting.” *Epidemiology of Injury in Adventure and Extreme Sports* 58: 98–111. https://doi.org/10.1159/000338698.

Gabe, Todd M., and Diane Hite. 2003. “The Effects of Boating Safety Regulations.” *Coastal Management* 31 (3): 247–54. https://doi.org/10.1080/08920750390198487.

Heggie, Travis W. 2018. “Lake Tourism Fatalities: A 46-Year History of Death at Lake Powell.” *Journal of Travel Medicine* 25 (1): 1–5. https://doi.org/10.1093/jtm/tay037.

Hudson, Diana, Robert Ekman, and Leif Svanström. 2007. “Survival of Immersions during Recreational Boating Events in Alaska, 1999-2004.” *Accident Analysis and Prevention* 39 (3): 437–43. https://doi.org/10.1016/j.aap.2005.10.002.

Lapa, Tennur Yerlisu, Adnan Turgut, and Tevfik Turgut. 2012. “Deaths by Drowning Incidents during Recreational Boating and Similar Activities.” *World Applied Sciences Journal* 17 (2): 233–38.

Lenorovitz, David R., Edward W. Karnes, and Brian Haygood. 2020. “Personal Watercraft (PWC) Injury Hazards–Analyses, Technical Advancements, and Continuing Safety Challenges.” *Theoretical Issues in Ergonomics Science* 21 (3): 285–311. https://doi.org/10.1080/1463922X.2020.1714095.

Mangione, T., A. Johnson, M. Sawyer, B. Greenwald, A. Pelletier, J. Gilchrist, and J. E. Tongren. 2008. “Paddle Sports Fatalities - Maine, 2000-2007.” *Morbidity and Mortality Weekly Report* 57 (19): 525–27.

McCarthy, Patrick, and Wayne K. Talley. 2001. “Safety Investments, Behaviours and Injury Severity.” *Applied Economics*, no. 33: 701–10.

McKnight, A. James, Wayne W. Becker, Anthony J. Pettit, and A. Scott McKnight. 2007. “Human Error in Recreational Boating.” *Accident Analysis and Prevention* 39 (2): 398–405. https://doi.org/10.1016/j.aap.2006.09.004.

Nævestad, T. O., A. Laiou, K. V. Størkersen, R. Phillips, G. Yannis, T. Bjørnskau, and A. Amundsen. 2018. “Maritime Safety Culture and Safety Behaviours in Greece and Norway: Comparing Professional Seafarers and Private Leisure Boat Users.” *Safety and Reliability - Safe Societies in a Changing World - Proceedings of the 28th International European Safety and Reliability Conference, ESREL 2018*, no. 2004: 2903–12. https://doi.org/10.1201/9781351174664-364.

Nathanson, Andrew T., Justin Mark J. Young, and Craig Young. 2015. “Pre-Participation Medical Evaluation for Adventure and Wilderness Watersports.” *Wilderness and Environmental Medicine* 26 (4): 55–

62. https://doi.org/10.1016/j.wem.2015.09.008.
Neville, Vernon, and Jonathan P. Folland. 2009. "The Epidemiology and Aetiology of Injuries in Sailing." *Sports Medicine* 39 (2): 129–45. https://doi.org/10.2165/00007256-200939020-00003.
Norwegian Maritime Authority. 2019. "Nasjonal Handlingsplan Mot Fritidsbåtulykker 2019-2023 (National Action Plan against Recreational Craft Accidents)."
———. 2021. "Dødsulykker Med Fritidsfartøy 2021 (Engl.: Fatalities with Recreational Craft 2021)."
Norwegian Ministry for Fisheries and Economy. 2015. "LOV-2015-06-19-65: Lov Om Fritids- Og Småbåter (Småbåtloven) (English: Law for Leisure and Small Boats (Small Boat Law)." Nærings- og fiskeridepartementet (engl. Ministry of Trade, Industry and Fisheries).
Øien, K. 2001. "Risk Indicators as a Tool for Risk Control." *Reliability Engineering and System Safety* 74 (2): 129–45. https://doi.org/10.1016/S0951-8320(01)00067-9.
Otamendi, F. Javier, and José Ramón González De Vega. 2013. "Assessing the Severity of Recreational Boating Accidents." *Proceedings - 27th European Conference on Modelling and Simulation, ECMS 2013*, 269–74. https://doi.org/10.7148/2013-0269.
Otamendi, F. Javier, and José Ramón González de Vega. 2014. "Recreational Boating Incidents Based on Marine Surveyors Reports: Economic, Safety and Prevention Issues across Spain." *Ocean and Coastal Management* 102 (PA): 65–71. https://doi.org/10.1016/j.ocecoaman.2014.09.015.
Øvergård, Kjell Ivar, Marius Stian Tannum, and Per Haavardtun. 2020. "Observation and Assessment of Crossing Situations between Pleasure Craft and a Small Passenger Ferry." *WMU Journal of Maritime Affairs* 19 (3): 337–55. https://doi.org/10.1007/s13437-020-00211-1.
Phillips, Maile T., Natalie Spitzer, Wendy Chow, and Thomas W. Mangione. 2019. "Risk Factors Associated with Life Jacket Wear among Adult Canoeists and Kayakers in the United States, 1999–2017." *International Journal of Injury Control and Safety Promotion* 26 (2): 176–84. https://doi.org/10.1080/17457300.2019.1576207.
Pitman, Sebastian. 2019. "Trends in the Wear of Personal Flotation Devices (PFDs) in the UK 2009-2017." *Injury Prevention* 25 (6): 585–88. https://doi.org/10.1136/injuryprev-2019-043213.
Quistberg, Duane Alex, Elizabeth Bennett, Linda Quan, and Beth E. Ebel. 2014. "Low Life Jacket Use among Adult Recreational Boaters: A Qualitative Study of Risk Perception and Behavior Factors." *Accident Analysis and Prevention* 62 (November 2016): 276–84. https://doi.org/10.1016/j.aap.2013.10.015.
Quistberg, Duane Alex, Linda Quan, Beth E. Ebel, Elizabeth E. Bennett, and Beth A. Mueller. 2014. "Barriers to Life Jacket Use among Adult Recreational Boaters." *Injury Prevention* 20 (4): 244–50. https://doi.org/10.1136/injuryprev-2013-040973.
Rizzo, Michael G., Sohil S. Desai, Dillon C. Benson, Fernando E. Vilella, and Seth D. Dodds. 2021. "Watercraft Propellers as a Mechanism of Orthopaedic Injuries: Injury Patterns, Management, and Complications." *European Journal of Trauma and Emergency Surgery*, no. 0123456789. https://doi.org/10.1007/s00068-021-01796-9.
Roberts, Stephen E., Detlef Nielsen, and Bogdan Jaremin. 2013. "Fatalities in Recreational Boating and Sub-Aqua Diving." *International Maritime Health* 64 (4): 207–14. https://doi.org/10.5603/IMH.2013.0006.
Ryan, Kevin M., Andrew T. Nathanson, Janette Baird, and Jenna Wheelhouse. 2016. "Injuries and Fatalities on Sailboats in the United States 2000-2011: An Analysis of US Coast Guard Data." *Wilderness and Environmental Medicine* 27 (1): 10–18. https://doi.org/10.1016/j.wem.2015.09.022.
Smith, Gordon S., Penelope M. Keyl, Jeffrey A. Hadley, Christopher L. Bartley, Robert D. Foss, William G. Tolbert, and James McKnight. 2001. "Drinking and Recreational Boating Fatalities." *Jama* 286 (23): 2974. https://doi.org/10.1001/jama.286.23.2974.
Spitzer, Natalie, Maile T. Phillips, Wendy Chow, and Thomas W. Mangione. 2018. "Factors Associated with Life Jacket Use among Cabin Sailboat and Day Sailor Boaters in the United States." *Journal of Safety Research* 65: 101–14. https://doi.org/10.1016/j.jsr.2018.02.002.
Swett, Robert A., Charles Sidman, Timothy Fik, Russell Watkins, and Paul Ouellette. 2011. "Evaluating Boating Safety Risk in Intracoastalwaterways." *Coastal Management* 39 (6): 613–27. https://doi.org/10.1080/08920753.2011.616661.
Toman, Ivan, Đani Mohović, Mate Barić, and Robert Mohović. 2020. "The Correlation between Strong Wind and Leisure Craft Grounding in Croatian Waters." *Transactions on Maritime Science* 9 (2): 224–35. https://doi.org/10.7225/toms.v09.n02.007.
Viauroux, Christelle, and Ali Gungor. 2016. "An Empirical Analysis of Life Jacket Effectiveness in Recreational Boating." *Risk Analysis* 36 (2): 302–19. https://doi.org/10.1111/risa.12449.
Vos, Marc de, and Christo Rautenbach. 2019. "Investigating the Connection between Metocean Conditions and Coastal User Safety: An Analysis of Search and Rescue Data." *Safety Science* 117 (March): 217–28. https://doi.org/10.1016/j.ssci.2019.03.029.
Willcox-Pidgeon, Stacey, A. E. Peden, Richard C. Franklin, and Justin Scarr. 2019. "Boating-Related Drowning in Australia: Epidemiology, Risk Factors and the Regulatory Environment." *Journal of Safety Research* 70: 117–25. https://doi.org/10.1016/j.jsr.2019.06.005.