ALCOHOL AND FATAL ACCIDENTS IN RECREATIONAL BOATING. A TEN YEAR STUDY IN FINLAND.

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Summary. The rate of alcohol positive operators in recreational motor boating varied from 12.6% to 30.8% (BAC 1.5 o/oo: from 0.4% to 2.5%) in Southern Finland in 1979-1989. In all fatal boating accidents studied by specific investigation teams in 1986-1988 the corresponding figures for all participants were 74.7% and 58.2%, respectively. Although life vests were present when required by the law they were not carried. More than 90% of drowned would probably have saved their lives by using them.

INTRODUCTION
Recreational boating is a style of Finnish life when the lakes and the sea are not frozen. Although it is forbidden by the law to operate or navigate a vessel, except a rowboat or another small non-motorized vehicle, if one's blood alcohol concentration exceeds the mandatory limit (BAC 1.50 o/oo), this statute is often neglected. As a consequence boating with high BACs often lends to an accident, and the number of persons killed annually in these accidents has been around 100 in the last ten years. According to official statistics two thirds of the fatal cases have been under the influence of alcohol (1).

In addition to fatal accidents little is known about the rate of drinking operators on waters. When the law came in effect (1977) the police was authorized to submit all operators of vehicles on the road and track, in the air, and on the waters to a breathtest even without a previous suspicion to detect the possible ingestion of alcohol. This legislation made us possible to carry out studies on the use of alcohol in recreational boating together with the Mobile Police (special police forces for the supervision of traffic), the Finnish Coast Guard and the National Board of Customs.

A longitudinal study on the frequency of drinking operating on waters in 1979-1989 is reported here together with results from all fatal boating accidents in Finland studied by special investigation teams in 1986-1988. A special emphasis is given on the presence of alcohol and the availability, use and effect of life vests in recreational boating and boating accidents.

METHODS

R-study on waters. Operators of motor boats were breathtested along the coastal waters from Naantali to Porvoo and on Lake Saimaa (1147 sq.kms), Lake Pijnne (1054 sq.kms), Lake Vesijrvi (108 sq.kms) and Lake Lohja (89 sq.kms) in Southern Finland annually in 1979-1988. The method used by us in road side surveys was followed as much as possible (2). Our team consisted in total of two to four motorboats of Mobile Police, Coast Guard and/or Customs each with at least two officers. The boats were located in a strait which the operators had to pass or the patrol boats moved along a passage allowing all operators to be easily tested with a breathalyser (Alcolmeter PST-M1, Lion Laboratories,
Ltd., Cardiff, U.K.). If the operator gave a positive test it was recorded and if it exceeded the mandatory limit we took a blood sample for the determination of BAC and carried out some clinical tests by the request of the police. We also recorded the type and size of the vessel, the power of engine, availability and use of life vests, and several other parameters of the boating occasion and interviewed the alcohol positive operators with respect to their drinking before the test.

In 1988 and 1989 we asked passengers over 15 years of age (N = 735; N of all passengers = 1092) to take a voluntarious breathtest which almost all of them accepted (98.1 %).

Study on fatal boating accidents (A-Study). The Department of Police of the Ministry of Interior decided in 1985 to begin a project with the aim to investigate fatal boating accidents. For this at least one team consisting of three members (police officer, specialist in boat technology and forensic pathologist) were formed in each of the twelve provinces including the autonomous province of The land Islands. Whenever a fatal boating accident occurred the team was called together. Members of the team carried out a thorough investigation on the scene interviewing those present and recorded ao. weather conditions, rescue equipment and inspected the condition of the boat and the engine (more than 50 items). A forensic autopsy was made in fatal cases where usually samples were taken for the determination of BAC. The relatives were interviewed ao. with respect to the drinking habit of the deceased. Special attention was paid to the alcohol use and the boating experience of the operator. The team wrote a mutual report describing the progress and the cause of the accident. They also recommended measures to be taken in order to avoid this kind of an accident in the future.

According to the Finnish law all persons killed in these accidents were submitted to a forensic autopsy, and we had access also to these police and autopsy reports.

CHI-square and t tests were used to test the statistical significance of the results.

RESULTS

Breath testing of operators in recreational boating (R-study)
Frequency of drinking operators. A total of 5440 operators in recreational boating have been breathalysed from 1979 to 1989 mainly on Fridays (afternoon) and Saturdays (morning-afternoon). The frequency of drinking operators detected annually is presented in Fig. 1. Although one of five or four operators gave a positive test the proportion of operators who had a BAC exceeding the mandatory limit was 1.1 % (range 0.4 - 2.5 %). The majority of BACs were low (Fig. 2).

Alcohol positive operators and passengers. It can be stated in general that the use/non-use of alcohol agrees in operators and passengers. In a comparison of operators to passengers at least 15 years of age it was found that when the operator was sober only 15.1 % of passengers had ingested alcohol and when the operator gave a positive breath test about one third (36.0 %) of the passengers were sober (Fig. 3).

The presence of passengers was reflected in the BACs of alcohol positive
operators. The mean BACs were 0.77, 0.63 and 0.43, 0.46 o/oo when the operators were alone or had passengers, respectively (p <0.01). On the other hand, the mean BACs of passengers did not differ statistically significantly with respect to the use/non-use of alcohol of the operator (BACs 0.41 and 0.34 o/oo, respectively).

Fatal boating accidents (A-study)

During the project period (1986-1988) 291 fatal accidents occurred with 294 boats. The number of people in these accidents was 510. They were mainly males (94.5 %) with an age of at least 15 years (96.2 %). Of all participants 340 (68.0 %) lost their lives and 319 (63.8 %) by drowning. Less than 5 % (4.2 %) died due to other reasons, mainly for skull fractures or acute illnesses.

**BAC and accidents.** BAC could be determined (from blood samples; operators) or estimated (from breath; living passengers) in 94.8 % of all 477 participants aged at least 15 years. When these persons were divided in three groups: A. The persons who got into water and drowned, B. The persons who got into water but were rescued, and C. The persons who stayed alive in the boat, no statistically significant differences could be found with respect to the use of alcohol. Neither differed the distribution curves of BAC's between these groups (Fig. 4). Alcohol negative persons comprised 21.5 %, 19.3 % and 18.8 % of the persons of the groups A, B and C, respectively. On the other hand, respective percentages for persons having a BAC exceeding 1.5 o/oo were 64.1, 53.4 and 66.7. Although the mean BAC was higher in the group A (1.58, 1.05 o/oo) as compared to those who were rescued from water (1.33, 0.87 o/oo), the difference was only almost significant (p <0.05).

Presence and use of life vests

According to the Finnish law it is obligatory to have but not to carry life vests in a boat if the power of the engine is more than 20 or 50 HP in boats run by petrol or diesel engines, respectively. In recreational boating (R-study) life vests could be found almost always (95 %) when required by the law but only in three quarters of boats when not mandatory. However, although life vests were present in the boat only c. every fourth person carried them. These rates of wearing life vests was only c. 10 % when the person had ingested alcohol.

In the fatal accident study both the presence of life vests (less than 10 % when not mandatory) as well as their use were of a considerably lower rate when compared to R-study (Table 1). More than 95 % (96.5 %) of the 318 persons who got into water and drowned did not use or were not able to use life vests because of lack of them in the boat. The fatal water accident investigation teams estimated that 74.6 % of the drowned would have saved their lives and an additional 18.5 % probably by using life vests.

**BAC and risk of a fatal boating accident**

The risk of an operator of a motor boat to be involved in a fatal boating accident was calculated from the B(r)ACs of the operators of both the accident study and the R-study in 1986-1988. The results show that when B(r)AC is at least 0.5 o/oo there is an eight-fold increase of the risk. At the mandatory BAC-limit on waters the risk is more than 20 times higher as compared to a BAC.
DISCUSSION

Finland is known as the country of thousands of lakes. In fact there are 188000 lakes with an area exceeding 500 sq.m and the length of the coast line (shoreline) is c. 1100 kms (4600). Compared to the Finnish population (over 4.9 million) the number of boats is high, c. 700 000 of which about 10 per cent are registered. Thus, it is obvious that recreational boating is a style of Finnish life when the lakes and the sea are not frozen. As a result fatal accidents happen and the National Board of Waters has recorded some characteristics annually. The mean of persons killed in boating accidents has been 107.4 (range 72 - 125) annually during the last ten years. In two of three fatalities (mean 64.1 %, range 54 - 80 %) alcohol was involved and in the average only 3.1 % (range 1 - 6 %) carried life vests (1).

Some earlier often sporadic investigations especially on the presence of alcohol in water transport and in fatal water accidents have been published from Finland (3-11) and elsewhere (12-17). To have a better understanding on the facts leading to a fatal accident the Ministry of Interior started a three year project partly reported here.

The R-study shows that when 28.4 % of operators and 35.8 % of adult (15 years) passengers gave a positive breath test in 1988 - 1989 alcohol plays a great role in recreational boating. Although the percentage of drunken operators exceeding the mandatory limit (1.5 o/oo) is low i.e. 1-2 % it is much higher than on the roads, 0.25 %, where the mandatory limit is only 0.5 o/oo (Penttil, Pikkarainen, 1990). High BAC's (1.5 o/oo) are encountered at least 30 times more often both for drowned and rescued persons in fatal accidents. In fact an intoxication (own or of some other participant) was estimated to be the main contributing factor in getting into water for c. 70 % of both the drowned and rescued aged at least 15 years. The main reason for drowning was in c. 50 % the loss of skills in swimming due to intoxication.

The presented risk of an operator of a motor boat to be involved in a fatal accident with increasing BACs should be considered with some precaution. Although the number of breath tests are distributed evenly between the sea and lake areas in the R-and A-studies there is a geographical as well as a monthly/daily difference. If these have no or a small effect only the use of alcohol even in small amounts might be dangerous. This might also be in favour to reduce the mandatory limit in the legislation.

The lack of life vests or when present not carried would have saved over 90 % of drowned. Thus, the most important means to reduce the number of fatal accidents are increased information on the effects of alcohol and rescue equipment and supervision of drinking operating on waters.

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LITERATURE


Table 1. The presence of life vests in the boat and the use of life vests in recreational boating (R-study) and in fatal boating accidents (A-study). In brackets the number of boats/persons.

![Bar Chart]

**Fig. 1** Pikkarainen & Penttilä T89/C 11

The proportion of alcohol positive operators of motor boats on coastal waters and lakes of Southern Finland in 1978-1989. Solid columns: Operators with a BrAC 0.1-1.4 o/oo and scattered columns: operators with a BrAC <0.1 and BrAC >1.4 o/oo.
Fig. 2 Pikkarainen & Penttilä T89/C 11

Distribution curves of Br(AC)'s of both operators and passengers in recreational boating (R-study) and in fatal boating accidents (A-study).

Fig. 3 Pikkarainen & Penttilä T89/C 11

The use of alcohol of passengers when operator was sober or had ingested alcohol.
Scattered columns: alcohol positive operators/passengers and open columns: alcohol negative operators/passengers.
The B(r)AC distribution curves in the accident study of A. persons who got into water and drowned; B. persons who got into water and were rescued; and C: persons who stayed alive in the boat.

The risk of an operator of a motor boat to be involved in a fatal boating accident with increasing B(r)AC.