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Role of alcohol in urgent ambulance contacts in 15-24-year-olds in Copenhagen: a descriptive population-based study

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ABSTRACT

Objective The objective of this study is to estimate the proportion of alcohol-related ambulance contacts and to describe characteristics of these contacts in young people.

Design A descriptive population-based study with alcohol-related ambulance contacts identified from free texts in prehospital medical records by a two-stepped approach; an automatic search for specific keywords followed by manual verification.

Setting Copenhagen, Denmark.

Participants A random sample (n=26 600) of all ambulance contacts in 15–24-year-olds between 10 March 2015 and 1 November 2022.

Main outcomes measure Proportion and relative proportion (RP) of alcohol-related ambulance contacts.

Results Of all ambulance contacts, 16% (n=4145) were alcohol related. Most alcohol-related contacts had acute alcohol intoxication (46%) as the primary cause followed by accident (23%). Alcohol-related contacts followed a clear circadian pattern with most contacts during night-time, peaking on Saturday and Sunday mornings between 03:00 and 04:00 hours with 59% and 55% of ambulance contacts being alcohol related. Compared with Mondays, the number of all ambulance contacts was 46% and 38% higher on Fridays and Saturdays, which was attributable to the large number of alcohol-related contacts. Alcohol-related contacts were more frequent in males compared with females (RP 1.46 (95% CI 1.37 to 1.55)) and equally frequent in 15–17- and 18–24-year-olds (RP 1.04, 95% CI 0.97 to 1.13).

Conclusion A large proportion of ambulance dispatches in young people is attributable to excessive alcohol drinking, even among minors. This emphasises a need for preventive measures to reduce the harmful effects of binge drinking in youth and the impact on the healthcare system.

INTRODUCTION

Harmful alcohol use increases the risk of several immediate and long-term health-related outcomes and worldwide alcohol is estimated to cause 5.3% of deaths and 5.1% of disability adjusted life years. The largest

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Excessive drinking is associated with increased risk of immediate harms, especially accidents and poisonings.
- ⇒ Immediate alcohol-related harm is a burden on emergency departments; however, the burden on the prehospital medical services has not been investigated thoroughly.

WHAT THIS STUDY ADDS

- ⇒ The burden of alcohol-related ambulance contacts in youth is significant. The majority of immediate alcohol-related harms were due to excessive drinking causing acute alcohol intoxication, and the use of prehospital medical services was disproportional with the need for medical intervention.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ Insight into the burden and circumstances of alcohol-related ambulance contacts can be used to tailor dispatch procedures and to improve preventive measures to reduce excessive alcohol drinking and related harms.

proportion of deaths being attributable to alcohol (13.5%) has been observed among people at younger ages (20–39 years), and unintentional injuries have been identified as the leading cause.¹ Thus, alcohol is an important risk factor for death and disability in the young.

Alcohol intoxication increases risk of immediate harmful consequences, especially injuries and poisonings. There is a dose-response relationship between blood alcohol concentration and risk of injury, explained by impaired motor function and reduced cognitive capabilities such as balance, coordination, reaction time, concentration and judgement.^{2–5} The severity of harm ranges from



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minor injuries and mild symptoms of poisonings (nausea and vomiting) to major trauma and life-threatening conditions due to respiratory depression.⁶ Drinking behaviours in young people are characterised by a high prevalence of binge drinking and a large average alcohol intake, both associated with alcohol intoxication.⁷ The Danish youth takes a leading position regarding both of these drinking behaviours with a monthly binge drinking prevalence of 59% and an average intake of 8.8 alcoholic units on alcohol drinking days, as measured in 15-year-olds.⁷ In addition to engaging in risky drinking behaviours, the adolescent period is marked by risk-taking and novelty-seeking actions, and the inhibitory control is not fully developed.⁵ Consequently, Danish youths are at particular risk of experiencing immediate alcohol-related harms.

Emergency department (ED) presentations are generally well investigated, and in young people 3%–4% are related to alcohol.^{8,9} This proportion is likely to be higher when ED presentations are due to accidents. Although this has not been specifically studied in youths, 26.8%–40.7% of adult patients presenting to ED due to an accident are intoxicated by alcohol.^{10–12}

Ambulance services have a key role in emergency medical services (EMS) aiming to provide rapid response and treatment in medical emergencies. Some emergencies are resolved on-site and patients are released at the scene without hospital referral.¹³ The total burden of alcohol-related harm in youth and contacts to the healthcare system may, therefore, be underestimated if prehospital contacts are not considered.

Nevertheless, only a few studies have aimed to investigate the prehospital burden of alcohol-related contacts. Studies from the UK suggest that between 10.1% and 16.2% of all ambulance contacts were alcohol related, with young people involved in a substantial proportion of these.^{14,15} More knowledge about the burden of alcohol-related harm in youth and characteristics of ambulance contacts is crucial to clarify the need for and target of preventive strategies to improve adolescent health.

The aim of this study was to assess the extent of and circumstances surrounding urgent ambulance contacts related to alcohol intake among adolescents aged 15–24 years in Copenhagen. Additionally, we also investigated the primary causes of alcohol-related ambulance contacts.

METHODS

We conducted a descriptive population-based study of ambulance contacts that occurred between 10 March 2015 and 1 November 2022, in young people aged 15–24 years in Copenhagen. We used data obtained in direct relation to medical calls and to the ambulance service. Ambulance contacts with an urgent ambulance response of level A or B were eligible for inclusion. Level A implies an immediate response with lights and sirens and level B implies a response within 25 min.^{13,16} A and B are the predominant ambulance response types and constitutes

99% of all ambulance contacts with a recorded response type in the study population.

Prehospital medical services in Copenhagen

Copenhagen, the capital region of Denmark, provides EMS to approximately 1.9 million citizens corresponding to 32% of the Danish population. Access to the EMS is organised via two telephone numbers, an emergency number (1-1-2) and an out-of-hours medical helpline for non-emergency calls (1813-MH). The emergency number (1-1-2) is to be used in potential life-threatening situations such as fire, traffic accidents and medical emergencies, and all health-related calls are redirected to the emergency medical coordination centre (EMCC).¹⁷ The out-of-hours medical helpline (1813-MH) is used for medical consultation in non-urgent situations but can also result in dispatch of an ambulance, or calls can be redirected to the EMCC, who may decide to dispatch an ambulance.¹⁸

Data flow and manual coding of free text in the prehospital medical record

At the EMCC, the healthcare professionals answering the call obtain information on key individual characteristics such as sex and age using a Computer Aided Dispatch System (LOGIS-CAD). A criteria-based emergency medical dispatch system (the Danish Index for Emergency Care) is employed to determine type and severity of the medical problem.¹⁶ From this, level of urgency is decided by the call taker, and the ambulance response level is selected accordingly.^{13,16}

Onsite, the ambulance personnel obtain a prehospital medical record (PMR) including a free text field for description of the event. As information on alcohol intake or intoxication is not a standardised part of registrations in the medical records, PMR free texts was the only way to assess whether alcohol was involved in ambulance contacts. These free texts vary in length and detail, and to extract necessary information they had to undergo a process involving two steps. First, we composed and applied a search string using relevant keywords with the purpose of identifying records that were possibly alcohol related. Next, all records identified by the automatic search were handled manually through a reading and coding procedure verifying if positive identifications by the search string was truly alcohol related. Additionally, from this coding procedure we extracted information regarding circumstances of the alcohol-related ambulance contact.

For the automatic search, a search string was developed by an iterative process. A simple combination of the words 'alcohol' and/or 'drunk' was applied to identify relevant records, and false negative identifications were used to refine the search string further. This process was repeated until settlement was made on a final search string that seemed to gain no further sensitivity (ie, that all true alcohol-related contacts came out positive on the automatic search). From this we expected, that nearly

all alcohol-related contacts were also identified by the automatic search. To empirically verify this impression, a random sample of 568 contacts underwent both automatic search and manual verification, blinded to the results of the search string. This number was estimated from an expected proportion of approximately 20% alcohol-related ambulance contacts with the null and alternative hypothesis set at 80% and 90%, respectively.

The sensitivity was assessed as the number of true alcohol positives identified by the search string divided by the number of alcohol positives identified by manual verification. Likewise, the specificity of the search string was assessed as the number of true alcohol negatives identified by search string divided by the number of alcohol negatives identified by manual verification. Sensitivity and specificity of the search string was 98% and 85%, respectively. The final search string contained the keywords (translated from Danish) 'alcohol, drunk, intoxicated, inebriated, drink, drank, vodka, beer, units, detoxication, night out, dangle'.

Extraction and categorisation of free text data from the medical records was carried out by three coders due to the large sample. To ensure high levels of inter-rater agreement, a written standardised coding procedure including definitions of variables and categories was developed and used by all coders. To develop this procedure, we studied medical records until data saturation was achieved (a sample of 400 records). By this, we gained insight into how events were generally described as well as the nature and detail level of information it was possible to extract. We used this knowledge to generate a systematic coding procedure used by all coders, including information on the event that led to the ambulance contact and if alcohol was involved in the ambulance contact. Inter-rater agreement between coders was tested by Cohens Kappa and found to be substantial for the two main variables obtained from manual coding (alcohol relatedness=0.89, primary cause of contact=0.76).

Variables

For all ambulance contacts, we included variables obtained from CAD containing information on the following characteristics of the patient and ambulance contact; age, sex, regional location, requestor, ambulance response level and hour and day of week. Age and sex were derived from the personal identification number when registered in CAD. Regional location was defined as geographical area of the ambulance contact. City centre was defined as the central part of Copenhagen covering zip codes from 1050 to 1499, and distal city centre was defined as areas bordering the city centre covering zip codes 1500–1974, 2100 and 2200. Suburbs and rural areas covered remaining zip codes in Copenhagen. Requestor was defined as way of entrance of medical call prior to dispatch of an ambulance. Initiation of the contact could be the emergency number, medical helpline or other (eg, hospital wards, police or other contacting EMCC directly). Date of ambulance contact

were included and comprised information about year, month, week, day of week and hour of week. Months were categorised into four seasons: spring (March to May), summer (June to August), autumn (September to November) and winter (December to February). Day of week was defined to include 24 hours from 12:00 hours the particular day to 12:00 hours the following day. Hour of week was defined to commence at 12:00 hour on Monday and included 168 hours. Weekends were defined as the period from Friday 12:00 to Sunday 12:00 hours, and night-time was defined as the hours from 20:00 to 06:00 hours. Termination of patient contact was divided into two categories of termination; terminated on-site or transferred to hospital.

For alcohol-related ambulance contacts, we obtained additional variables from the manual coding of PMR free texts. In addition to alcohol relatedness, we included primary cause of ambulance contact, mechanism of accident, type of traffic accident, body region of injury, if the patient had taken any drugs, and who called for the ambulance.

An ambulance contact was considered to be alcohol related if the patient was under influence of alcohol at the time of the contact. If the patient was described as drunk, alcohol intoxicated, inebriated etc, the ambulance contact was considered to be alcohol related. If the patient was not explicitly described to be under the influence of alcohol but alcohol intake was stated in the PMR free-text, information on blood alcohol concentration, amounts of alcohol ingested and behaviour and clinical signs of the patient was assessed by the manual coder. Based on this information coders determined whether the ambulance contact was alcohol related or not. Primary cause of ambulance contact was based on symptoms and other medical assessments stated by ambulance personnel and included accident, acute alcohol intoxication, psychiatric symptoms, assault/violence, self-harm/suicidal behaviour, symptoms of diagnosed somatic disease and a category of other causes. Mechanism of accident included falls, traffic accidents and a category of other types/not stated. Type of traffic accidents was further specified and included bicycle, pedestrian, car (driver), car (passenger), scooter, motorbike/moped and a category of other types/not stated. Injured regions of the body included head/neck/face, extremities and a category of other body regions or not stated.

Drug intake was based on statements by ambulance personnel with the categories 'yes' and 'no' when intake or absence was confirmed. When drug intake was not stated or only suspected, intake was determined 'not stated'. Caller was defined as the person calling for the ambulance and was divided into four categories; unfamiliar person, relative/friend, patient themselves and not stated.

Due to the origin of data, missingness was generally low. Missing was only observed for regional location (1.6%), termination of patient contact (0.64%) and regional location (1.62%). For all other variables, data were complete.

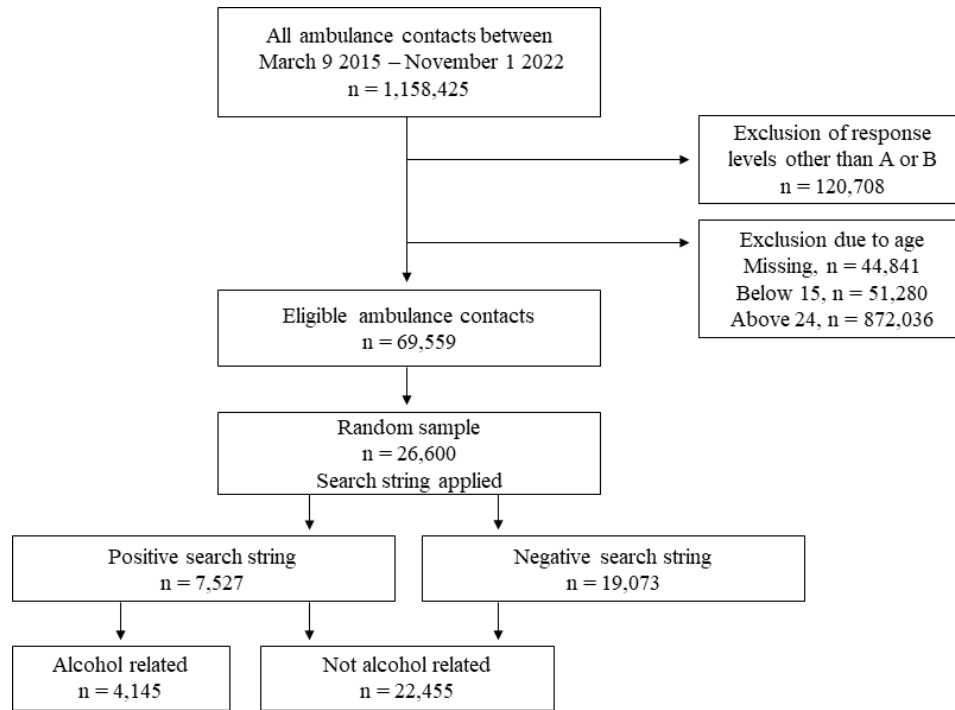


Figure 1 Flow chart of inclusion and exclusion, sampling and application of search string.

Final study sample

Due to the resource intensity of manual coding of PMR free texts, we did not include the total number of ambulance contacts but drew a sample. We aimed at a study population of approximately 25 000 ambulance contacts. The sample size was determined from the proportion of alcohol-related ambulance contacts and the distribution of primary causes of contact in a pilot test. This sample size allowed a margin of random error at 2% to achieve high precision on the proportion estimates.¹⁹ In the period between 10 March 2015 and 1 November 2022, a total of 69 559 ambulance contacts, regardless of alcohol intake, were of level A or B and involved young people aged 15–24 years. From the total number of ambulance contacts occurring in the study period, a random sample of 26 600 (38%) ambulance contacts were drawn, constituting the data sample for further study (figure 1).

Statistical analysis

Numbers and proportions of alcohol-related ambulance contacts were presented for each characteristic included in the study. Cause of ambulance contact was presented by sex and age. Incidence rates were calculated as the number of ambulance contacts per 10 000 population using age specific population size in the second quarter of each year in the study period. Univariable Poisson regressions were performed to estimate relative proportions (RP) and 95% CIs. Alcohol relatedness was included as dependent variable in all models, and sex, age group, requestor, response level, termination of contact, regional area, day of week and season were included as independent variables. Cubic splines were used for illustrative purposes to model fluctuations of hour of week by

fitting a spline function of time. The dependent variable, alcohol relatedness, and a single time variable at a time were included in these models. By spline functions based on data intervals, a smoother curve illustrating proportion of alcohol-related ambulance contacts by hour of week and week of study period was generated.²⁰

National COVID-19 restrictions were introduced in March 2020 and maintained until June 2021. We performed additional analyses to examine how this period affected the overall proportion of alcohol-related ambulance contacts. Cubic splines were used for illustrating the proportion of alcohol-related contacts during each week of the study period. Additionally, we performed a sensitivity analysis excluding all ambulance contacts that occurred during the period with national restrictions (March 2020 to September 2021). As included variables were complete or with only few missing, missingness was not handled statistically. STATA V.17 was used to perform analyses.

Patient and public involvement

No patients involved.

RESULTS

Of 26 600 ambulance contacts in 15–24-year-olds, 4145 (16%) were identified as alcohol related (table 1). The total rate of ambulance contacts was 151 per 10 000 person-years, and the rate of alcohol-related ambulance contacts was 23 per 10 000 person-years. In males, 19% of contacts were alcohol related as compared with 13% in females, translating to a RP of 1.46 (95% CI 1.37 to 1.55). The proportion of alcohol-related contacts was similar in

Table 1 Number of total, non-alcohol-related and alcohol-related ambulance contacts and relative proportion of alcohol-related contacts by characteristics, in a sample of young people aged 15–24 in Copenhagen, Denmark, between March 2015 and November 2022

| | Contacts, N (%) | | | Proportion alcohol-related | |
|--------------------------|-----------------|---------------------|-----------------|----------------------------|---------------------|
| | Total | Non-alcohol related | Alcohol related | % | RP (95% CI) |
| Total | 26600 | 22455 (84) | 4145 (16) | | |
| Sex | | | | | |
| Female | 14087 (53) | 12282 (55) | 1805 (44) | 13 | 1.00 (ref) |
| Male | 12513 (47) | 10173 (45) | 2340 (56) | 19 | 1.46 (1.37 to 1.55) |
| Age | | | | | |
| 15–17 | 5574 (21) | 4735 (21) | 839 (20) | 15 | 1.00 (ref) |
| 18–24 | 21026 (79) | 17720 (79) | 3306 (80) | 16 | 1.04 (0.97 to 1.13) |
| Requestor | | | | | |
| Emergency no | 17474 (65) | 13999 (62) | 3475 (84) | 20 | 3.64 (3.24 to 4.10) |
| Medical helpline | 5478 (21) | 5179 (23) | 299 (7.2) | 5.5 | 1.00 (ref) |
| Other | 3648 (14) | 3277 (15) | 371 (9.0) | 10 | 1.86 (1.60 to 2.17) |
| Ambulance response level | | | | | |
| A-level | 13742 (52) | 12028 (54) | 1714 (41) | 12 | 1.00 (ref) |
| B-level | 12858 (48) | 10427 (46) | 2431 (59) | 19 | 1.52 (1.42 to 1.61) |
| Termination of contact | | | | | |
| Hospital | 20785 (79) | 17827 (80) | 2958 (72) | 14 | 1.00 (ref) |
| On-site | 5644 (21) | 4481 (20) | 1163 (28) | 21 | 1.45 (1.35 to 1.55) |
| Regional area | | | | | |
| Suburbs and rural areas | 19954 (76) | 17660 (80) | 2294 (56) | 12 | 1.00 (ref) |
| Distal city centre | 4070 (16) | 3227 (15) | 843 (21) | 21 | 1.80 (1.66 to 1.95) |
| City centre | 2145 (8.2) | 1185 (5.4) | 960 (23) | 45 | 3.89 (3.61 to 4.20) |

RP, relative proportion.

those aged 15–17 and 18–24 years (RP 1.04 (95% CI 0.97 to 1.13)). Alcohol-related ambulance contacts were characterised by relatively more dispatches to the city centre (RP 3.89 (95% CI 3.61 to 4.20)), contact initiations by calling the emergency number (RP 3.64 (95% CI 3.24 to 4.10) and B-level responses (RP 1.52 (95% CI 1.42 to 1.61) (table 1).

The majority of alcohol-related ambulance contacts had acute alcohol intoxication (n=1893, 46%) as the primary cause of ambulance contact followed by accidents (n=1012, 24%). Other primary causes of contact included psychiatric symptoms (n=391, 9.4%), assault/violence (n=253, 6.1%), symptoms of a diagnosed somatic disease (n=138, 3.3%) and self-harm/suicidal behaviour (n=124, 3.0%). Furthermore, 334 (8.1%) of alcohol-related ambulance contacts were due to symptoms and conditions that did not fit into one of the above categories. (figure 2). More male than female contacts were due to accidents (27% vs 21%) and assault/violence (9.5% vs 1.7%), while more contacts in females compared with males were due to psychiatric symptoms (15% vs 5.1%) and self-harm/suicidal behaviour (4.6% vs 1.8%) (figure 2, upper panel). Relatively more contacts in the youngest (15–17years) as compared with the

oldest age group (18–24years) were due to acute alcohol intoxications and relatively more contacts in the oldest as compared with the youngest were due to accidents (figure 2, lower panel).

In contacts with accident as the primary cause of ambulance contact, 581 (57%) were caused by falls, and 302 (30%) were caused by traffic accidents. When differentiating between types of traffic accidents, bikes were involved in 213 (71%) of these. Furthermore, in patients involved in alcohol-related accidents, 652 (64%) had injuries located in head, face or neck, and 297 (29%) had injuries located to the extremities.

Relatively more alcohol-related ambulance contacts were terminated on-site (RP 1.45 (95% CI 1.35 to 1.55) as compared with not alcohol-related contacts (the subtraction of total and alcohol-related contacts). In alcohol-related ambulance contacts, 28% of patients were terminated on-site compared with only 20% of patients involved in not alcohol-related contacts. The proportion of on-site terminations was especially high for patients presenting with acute alcohol intoxication as the primary cause of ambulance contact (36%).

The total number of ambulance contacts during the week followed a circadian pattern, which was generally

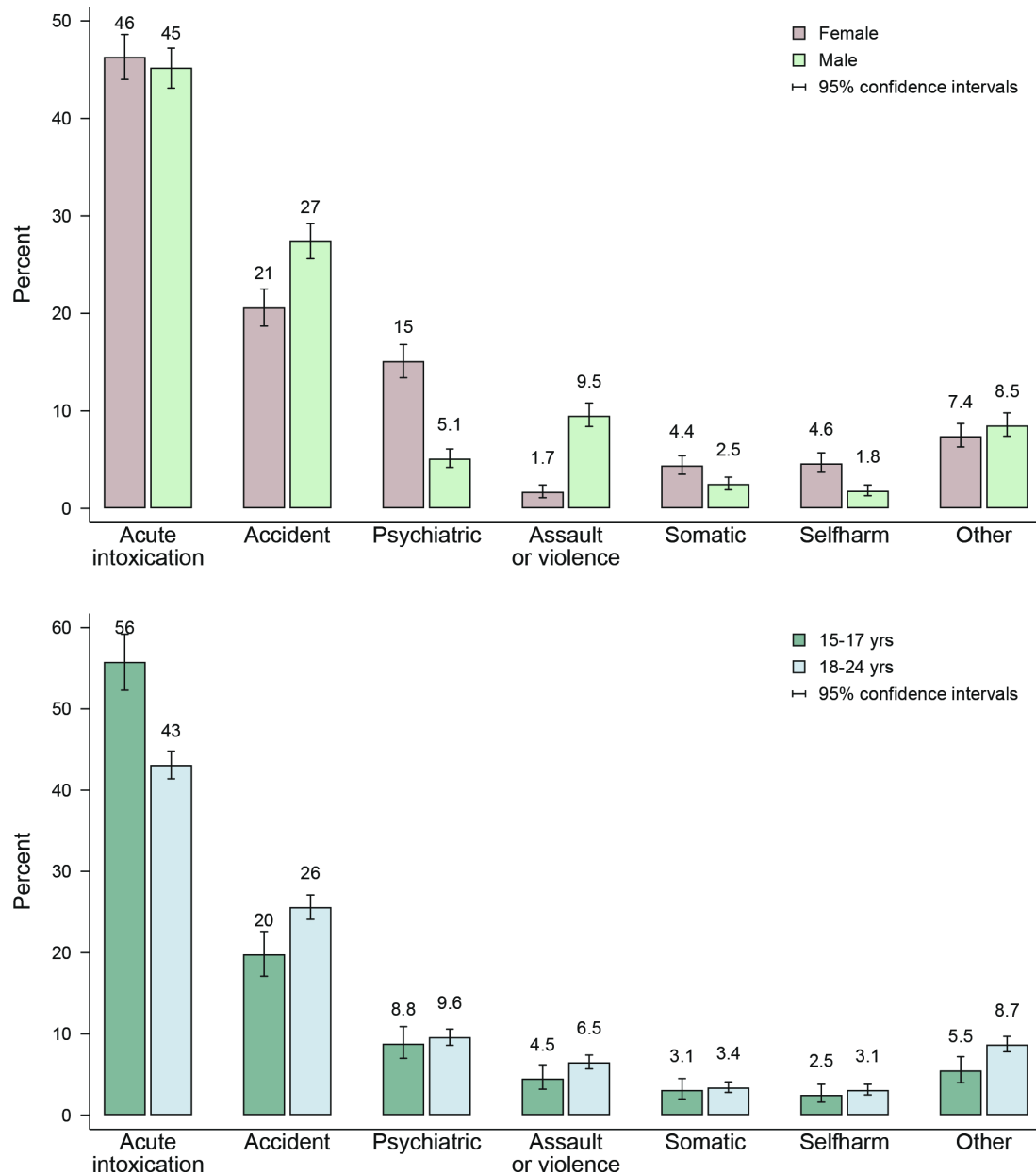


Figure 2 Proportion of cause of alcohol-related ambulance contact in a sample of young people aged 15–24 in Copenhagen, Denmark, between March 2015 and November 2022, by sex (upper panel) and age group (lower panel).

highest during day hours and lowest during night hours; however, with a marked increase during weekend days, especially in the night hours following Fridays and Saturdays (figure 3 upper panel, green line). For non-alcohol-related ambulance contacts, a consistent circadian pattern was observed but without a clear difference between weekdays and weekend days (figure 3 upper panel, rosa line). The number of alcohol-related contacts also followed a circadian pattern, however, with lowest number of contacts during the day hours and highest number during night hours (figure 3 upper panel, blue line). The proportion of alcohol-related ambulance contacts peaked on Saturday and Sunday mornings at 03:00–04:00 hours with 59% and 55% of ambulance contacts being alcohol related (figure 3, lower panel). In

strata of sex and age, the weekly pattern of alcohol-related ambulance contacts was remarkably similar (figure 4).

All over, there were 46% and 38% more ambulance contacts on Fridays and Saturdays as compared with Mondays (table 2). On Fridays and Saturdays, the number of alcohol-related ambulance contacts increased approximately sixfold compared with Mondays, while the number of non-alcohol-related ambulance contacts increased only slightly on weekend days as compared with Mondays. For instance, the number of non-alcohol-related ambulance was only 7% higher on Saturdays as compared with Mondays (RP 1.07 (95% CI 1.02 to 1.12)) (table 2). Also, the largest proportion of alcohol-related ambulance contacts was observed during summer (17%) (online supplemental table S1). All over, 38% and 33%

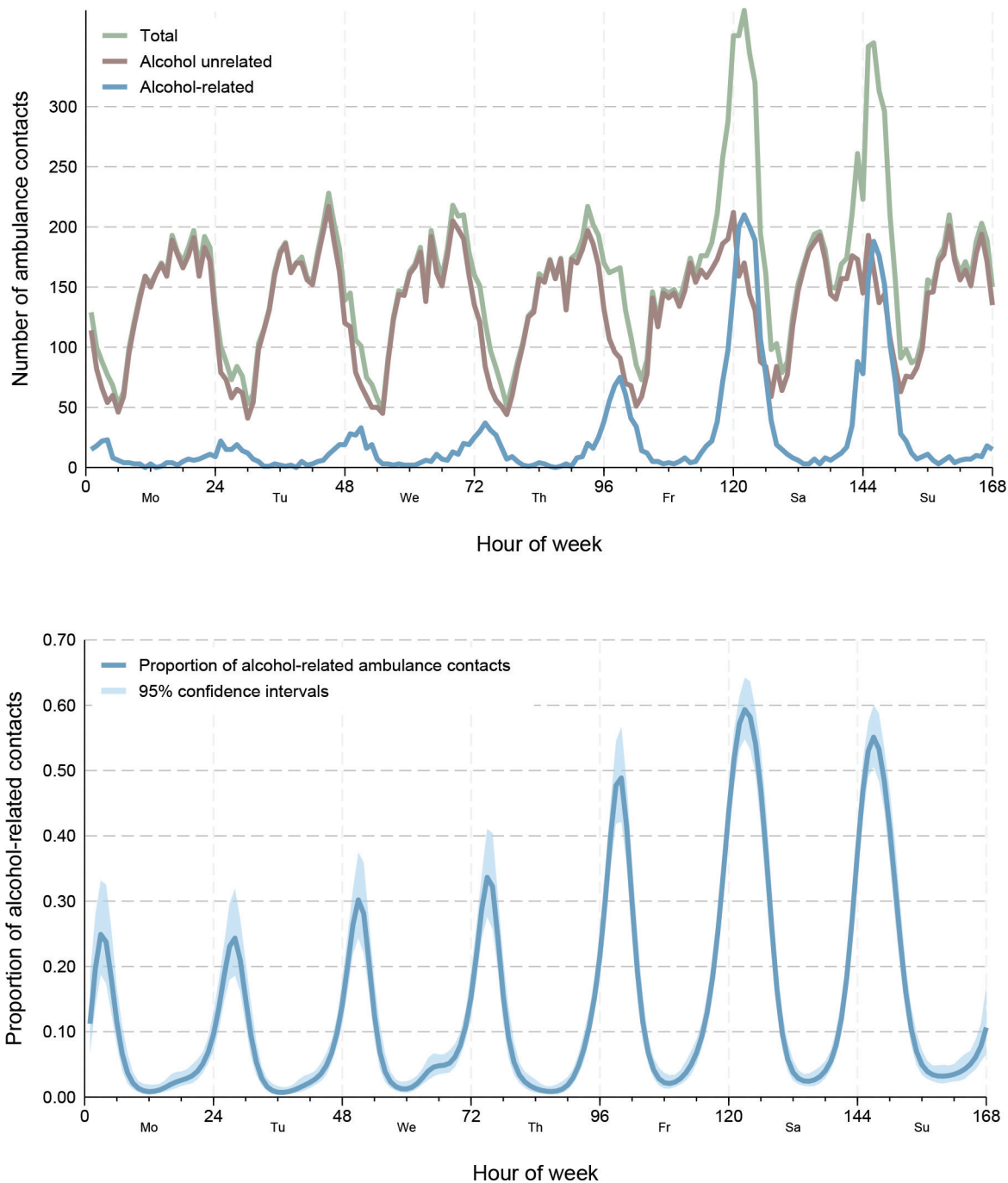


Figure 3 Number of total, non-alcohol-related and alcohol-related ambulance contacts (upper panel) and proportion of alcohol-related contacts estimated from cubic spline functions (lower panel) in a sample of young people aged 15–24 in Copenhagen, Denmark, between March 2015 and November 2022, by hour of week.

more alcohol-related ambulance contacts were observed in June and July as compared with March (online supplemental figure S1).

The proportion of alcohol-related contacts was generally stable over years, however, with slightly lower levels in 2020 and certain months in 2021 (online supplemental figure S2). Since phasing out restrictions, the proportion of alcohol-related contacts raised to levels similar to those in years prior to COVID-19. Excluding contacts that occurred during the period with national restrictions, the overall proportion of

alcohol-related ambulance contacts was 16.3% (95% CI 15.78 to 16.84) as compared with 15.6% (95% CI 15.12 to 16.06) during the entire period.

Drugs were confirmed involved in 16% of alcohol-related ambulance contacts, whereas 15% was confirmed not to involve drugs. In most of the alcohol-related ambulance contacts (69%), drug intake could not be determined due to missing information in PMR free-texts.

In 41% of alcohol-related ambulance contacts, a friend or a relative called for the ambulance. In 13%

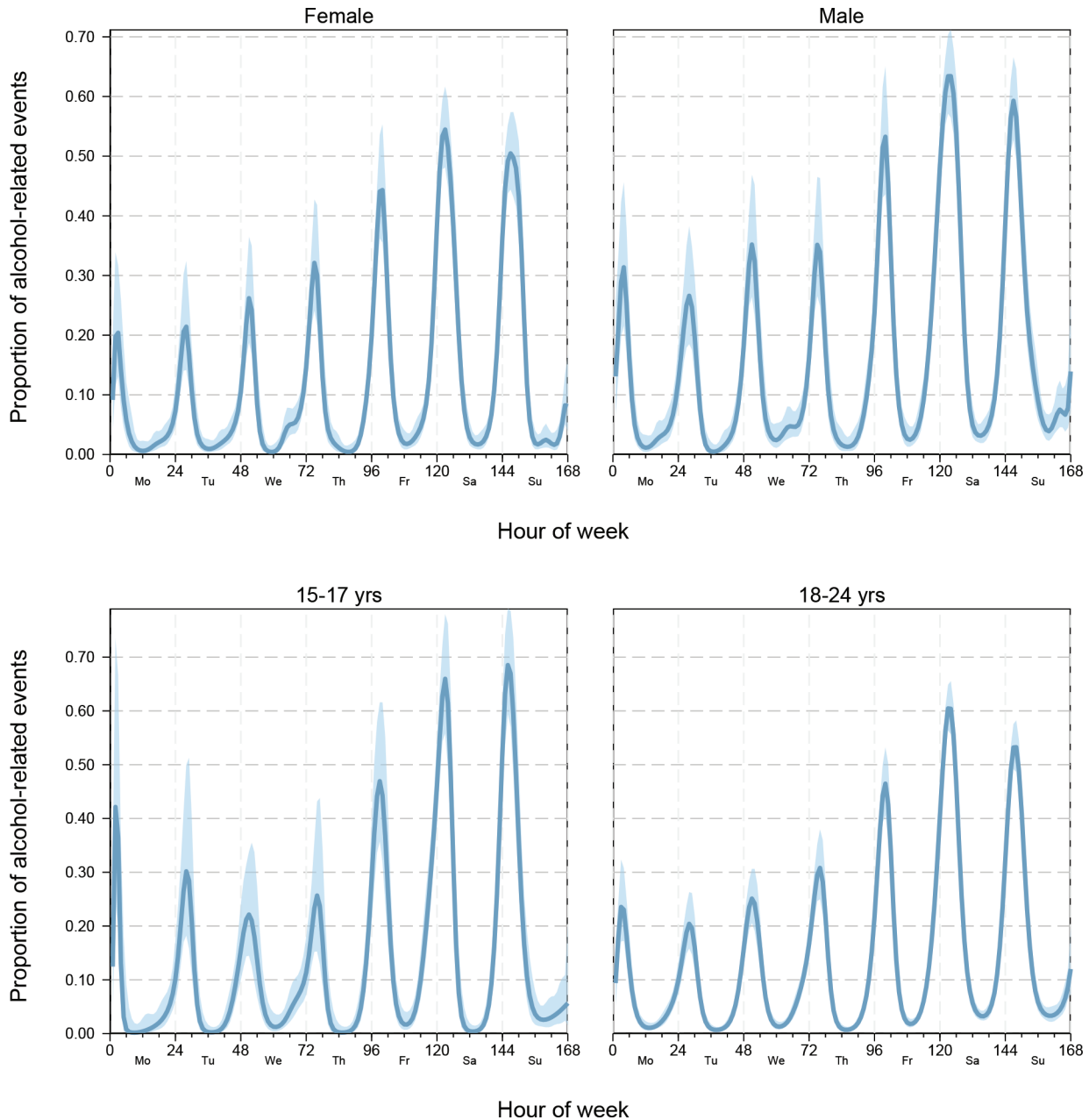


Figure 4 Proportion of alcohol-related ambulance contacts estimated from cubic spline functions in a sample of young people aged 15–24 in Copenhagen, Denmark, between March 2015 and November 2022, by hour of week in subgroups of sex (upper panels) and age group (lower panels).

of the contacts, the call was made by an unfamiliar person, and in just 0.7% by the patient themselves. In 46% of alcohol-related contacts, caller could not be determined.

DISCUSSION

Our main aim was to investigate the extent of and circumstances surrounding alcohol-related ambulance contacts including the underlying cause of contact in 15–24-year-olds in Copenhagen. From March 2015 to November 2022, 16% of ambulance contacts in 15–24-year-olds were alcohol-related and the rate of alcohol-related ambulance contacts was 23 per 10000.

The most frequent primary cause was acute alcohol intoxication (46%), equally frequent in males and females and more frequent in 15–17-year-olds compared with 18–24-year-olds.

Our estimated proportion of alcohol-related contacts is relatively close to previous findings from the UK. Manca *et al* found that among 0–24-year-olds in Scotland, 24% of ambulance contacts were related to alcohol. However, their definition encompassed not only patients acutely intoxicated by alcohol but also contacts that are in other ways related to alcohol, for example, alcohol dependency. Also, Manca *et al* utilised an additional source of information on alcohol intake, specifically an 'alcohol

Table 2 Number of total, non-alcohol-related and alcohol-related ambulance contacts and relative proportion of alcohol-related contacts, by weekday from noon same day to noon next day, in a sample of young people aged 15–24 in Copenhagen, Denmark, between March 2015 and November 2022.

| Weekday | N (%) | RP (95% CI) |
|---------------------|-------------|---------------------|
| All contacts | | |
| Monday | 3320 (12.5) | 1.00 (ref) |
| Tuesday | 3415 (12.8) | 1.03 (0.98 to 1.08) |
| Wednesday | 3432 (12.9) | 1.03 (0.99 to 1.08) |
| Thursday | 3660 (13.8) | 1.10 (1.05 to 1.16) |
| Friday | 4835 (18.2) | 1.46 (1.39 to 1.52) |
| Saturday | 4568 (17.2) | 1.38 (1.32 to 1.44) |
| Sunday | 3370 (12.7) | 1.02 (0.97 to 1.06) |
| Not alcohol related | | |
| Monday | 3139 (14.0) | 1.00 (ref) |
| Tuesday | 3182 (14.2) | 1.01 (0.96 to 1.06) |
| Wednesday | 3131 (13.9) | 1.00 (0.95 to 1.05) |
| Thursday | 3158 (14.1) | 1.01 (0.96 to 1.06) |
| Friday | 3323 (14.8) | 1.06 (1.01 to 1.11) |
| Saturday | 3362 (15.0) | 1.07 (1.02 to 1.12) |
| Sunday | 3160 (14.1) | 1.01 (0.96 to 1.06) |
| Alcohol related | | |
| Monday | 181 (4.4) | 1.00 (ref) |
| Tuesday | 233 (5.6) | 1.29 (1.06 to 1.56) |
| Wednesday | 301 (7.3) | 1.66 (1.38 to 2.00) |
| Thursday | 502 (12.1) | 2.77 (2.34 to 3.29) |
| Friday | 1512 (36.5) | 8.35 (7.16 to 9.75) |
| Saturday | 1206 (29.1) | 6.66 (5.70 to 7.79) |
| Sunday | 210 (5.1) | 1.16 (0.95 to 1.42) |

RP, relative proportion.

flag', which could be selected by ambulance personnel in the medical record if they considered the contact to be alcohol related. Furthermore, Martin *et al* found that youths were involved in a large proportion of alcohol-related ambulance contacts in Northeast of England. Sixteen per cent occurred among 10–19-year-olds and 25% among 20–29-year-olds.^{14 15}

Acute alcohol intoxications accounted for most alcohol-related ambulance contacts (46%), followed by accidents (23%) whereas intoxications as primary cause may be less accountable for alcohol-related emergency hospital admissions (10%).⁸ Instead, alcohol-related accidents, violence and self-harm have been reported as common causes for ED presentations.⁸ Males experienced more accidents and violence whereas women experienced more mental distress and self-harm/suicidal behaviour.

The largest number and proportion of alcohol-related ambulance contacts were observed in night-time and

weekends, and the total number of ambulance contacts was approximately 40% higher during weekends compared with weekdays. This increased number was almost exclusively attributable to the increased number of alcohol-related contacts. The diurnal patterns are supported by previous findings in studies of contacts to both prehospital medical services and EDs.^{10 12 14 15} These patterns underpin the magnitude of harm related to the alcohol culture at parties and nightlife in young people, and that the burden on the healthcare system is significant.

A large proportion of alcohol-related ambulance contacts were terminated on-site (28%). This might be explained by the large proportion of alcohol-related contacts being due to acute alcohol intoxications (46%) in which the proportion of terminations on-site is especially high. This finding may indicate a disproportional use of prehospital resources relative to the need for medical intervention. Furthermore, the large proportion of on-site terminations also highlights that clinical consequences from excessive drinking are not fully covered if only ED admissions and not prehospital contacts are studied.

When interpreting the estimated proportion of alcohol-related ambulance contacts, two things must be taken into consideration. First, we estimated the proportion of ambulance contacts associated with but not necessarily caused by alcohol. For some contacts, it is reasonable to assume that alcohol was the direct reason or a significant contributing factor (especially acute alcohol intoxication and accidents), but for other causes of contact the relationship between medical problem and alcohol intake is not clear-cut. Second, 17% of the alcohol-related ambulance contacts involved patients with combined intake of alcohol and drugs, and a substantial part of the ambulance contacts is therefore not related to alcohol alone. Thus, our estimated proportion of alcohol-related contacts might not only include ambulance contacts caused by alcohol alone.

Excluding ambulance contacts that occurred during the period with COVID-19 restrictions had no major impact on the overall proportion of alcohol-related ambulance contacts. Therefore, we believe that including these years in the study period does not harm generalisability of the findings.

We included only contacts that triggered an ambulance response. All alcohol-related calls to the EMCC that did not result in an ambulance response where, therefore, not included although these also constitutes a burden to the prehospital medical service.²¹

Strengths and limitations

The main strength of this study is the use of routinely collected service data from a large and representative sample of all ambulance contacts in 15–24 between 2015 and 2022 in Copenhagen. Despite manual coding of free-text fields from PMRs being resource demanding, access to these gave detailed information about alcohol

intoxication not registered elsewhere in the prehospital records. Furthermore, the manual coding also enabled us to investigate the medical causes of alcohol-related ambulance contacts which have, to our knowledge, not previously been investigated.

It was a limitation that data were collected with clinical purposes. Without standardised procedures for filling out free-text fields in the PMR, the content of these is diverse and with different levels of details thus some information of interest is non-specifically described or missing. This might have affected our ability to identify alcohol-related ambulance contacts, as these could only be assessed alcohol-related when information on alcohol intoxication or intake was stated in the PMR free-text. Therefore, the estimated number and proportion of alcohol-related contacts might be underestimated. This might be minor issue when acute alcohol intoxication is primary cause of contact, but it could be substantial for other causes of contacts.

In addition, we might have underestimated the number of alcohol-related contacts, in cases where we were not able to extract information on age due to missing personal identification number, or when age was not registered manually (approximate 4% of all ambulance contacts). A Danish study found that of emergency calls not triggering an ambulance response, a large proportion of contacts without personal identification number was alcohol related. Also, the estimated number and proportion of alcohol-related ambulance contacts did not include victims of alcohol-related violence or assaults, if it was not stated that victims themselves had been drinking alcohol.²²

Finally, despite using standardised coding procedure, it is important to acknowledge that subjectivity and bias associated with manual extraction of data is impossible to elimination completely. Also, primary cause of ambulance contact was based on symptoms and physical examinations stated by ambulance personnel in the PMR free-text field and not preliminary or final diagnosis. Assessment of the primary cause of contacts based on this information was highly dependent on the detail level of the PMRs and was not straight forward in all cases.

CONCLUSION AND IMPLICATIONS

Our results highlight that alcohol-related ambulance contacts constitute 16% of all ambulance contacts among 15–24-year-olds in Copenhagen, even in minors. This emphasises a widespread and unhealthy alcohol culture in the Danish youth.⁷ Most contacts are caused by excessive drinking causing acute alcohol intoxications and are thus preventable. Such ambulance callouts represent a significant and disproportional use of resources relative to the need for medical intervention. These novel insights call for tailoring the dispatch of ambulances to improve the prioritisation of limited prehospital resources. Furthermore, preventive measures could be strengthened with

the purpose of protecting young people from harmful effects of binge drinking.

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Table S1: Proportion of alcohol-related ambulance contacts by season in 15-24-year-olds in Copenhagen, Denmark, between March 2015 and November 2022.

| | Contacts, N (%) | | | Proportion alcohol-related | |
|--------|-----------------|---------------------|-----------------|----------------------------|-------------------|
| | Total | Non-alcohol-related | Alcohol-related | % | RP (95% CI) |
| Total | 26,600 | 22,455 (84) | 4,145 (16) | | |
| Season | | | | | |
| Spring | 6,876 (26) | 5,871 (26) | 1,005 (24) | 15 | 1.00 (ref) |
| Summer | 7,209 (27) | 5,991 (27) | 1,218 (29) | 17 | 1.16 (1.06, 1.26) |
| Autumn | 6,921 (26) | 5,835 (26) | 1,086 (26) | 16 | 1.07 (0.99, 1.17) |
| Winter | 5,594 (21) | 4,758 (21) | 836 (20) | 15 | 1.02 (0.93, 1.12) |

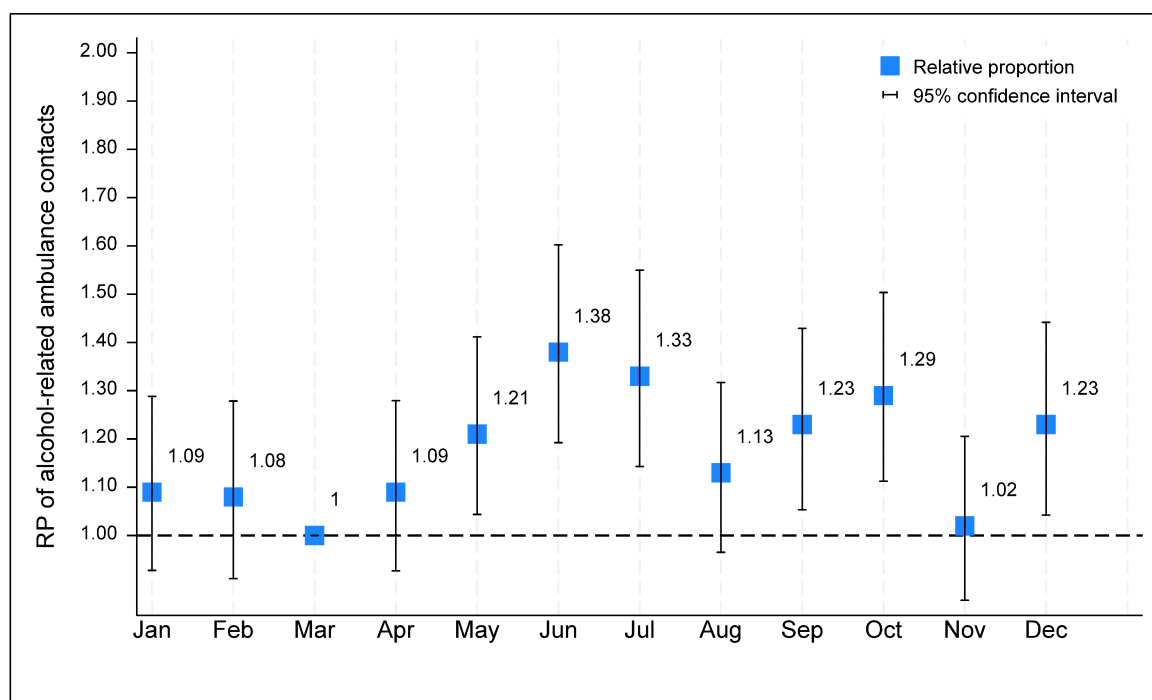
Figure S1: Relative proportion (RP) of alcohol-related ambulance contacts by month in 15-24-year-olds in Copenhagen, Denmark, between March 2015 and November 2015.

Figure S2: Proportion of alcohol-related ambulance contacts by time among 15-24-year-olds in Copenhagen, Denmark, between March 2014 and November 2022, using cubic spline functions.

