Original Investigation

Syncope and Motor Vehicle Crash Risk
A Danish Nationwide Study

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IMPORTANCE Syncope may have serious consequences for traffic safety. Current clinical guideline recommendations on driving following syncope are primarily based on expert consensus.

OBJECTIVE To identify whether there is excess risk of motor vehicle crashes among patients with syncope compared with the general population.

DESIGN, SETTING, AND PARTICIPANTS Danish nationwide cohort study from January 1, 2008, to December 31, 2012. Through individual-level linkage of nationwide administrative registers, all Danish residents 18 years or older were identified. Of 4 265 301 eligible Danish residents, we identified 41 039 individuals with a first-time diagnosis of syncope from emergency department or hospital.

MAIN OUTCOMES AND MEASURES Rate of motor vehicle crashes (including nonfatal and fatal crashes), based on multivariate Poisson regression models, using the total Danish population as reference.

RESULTS The 41 039 patients with syncope had a median age of 66 years (interquartile range [IQR], 47-78 years); 51.0% were women; and 34.8% had cardiovascular disease. Through a median follow-up of 2.0 years (IQR, 0.8-3.3 years), 1791 patients with syncope (4.4%) had a motor vehicle crash, 78.1% of which led to injury (n = 1398) and 0.3% to death (n = 6). The crude incidence rate of motor vehicle crashes was almost doubled among patients with syncope (20.6 per 1000 person-years; 95% CI, 19.7-21.6) compared with the general population (12.1; 95% CI, 12.0-12.1), with a rate ratio (RR) of 1.83 (95% CI, 1.74-1.91) after adjustment for age, sex, socioeconomic position, and relevant comorbidities and pharmacotherapy. Men had a relatively higher rate of motor vehicle crashes (RR, 1.91; 95% CI, 1.79-2.03) than women (RR, 1.74; 95% CI, 1.63-1.87). The excess risk of motor vehicle crashes persisted throughout the follow-up period. The 5-year crash risk following syncope was 8.2% (95% CI, 7.5%-8.8%) among the population aged 18 to 69 years compared with 5.1% (95% CI, 4.7%-5.4%) in the general population.

CONCLUSIONS AND RELEVANCE Prior hospitalization for syncope was associated with increased risk of motor vehicle crashes throughout the follow-up period. This study suggests that syncope should be considered as one of several factors in a broad assessment of fitness to drive.

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Syncope is characterized by a sudden loss of consciousness, although with spontaneous and complete recovery,[1] and could have serious consequences for public safety if it occurs in the driver of a motor vehicle. The lifetime cumulative incidence of syncope is 35%, and the cause usually differs in young and elderly individuals.[1-3] In addition, about one-third of patients with syncope will experience recurrent events within 3 years,[1,4,5] so physicians face a difficult judgment about whether patients with syncope are fit to drive.[6]

Driver incapacity as a result of sudden medical illness appears to be an unusual cause of motor vehicle crashes, perhaps only 1% to 3%.[7-9] Although overall crash rates have decreased, traffic crashes remain a leading cause of death and disability.[10] Some studies have suggested that the incidence of syncope while driving is 2% to 10%,[11-15] but these studies were small, usually based on self-reported data among syncope subpopulations, and had limited information about follow-up crash risk. Consequently, current guideline recommendations on syncope and driving are mainly based on expert consensus, corresponding to level C evidence.[1,16-19] According to the European Society of Cardiology,[1] reflex syncope should not lead to driving restrictions. In contrast, the guidelines suggest driving restrictions in case of recurrent syncope, substantial cardiovascular comorbidities, or "unexplained syncope," unless definitive treatment can be ensured.[1] Recommendations from the Canadian Cardiovascular Society are similar.[16]

Motor vehicle travel in developed countries plays an essential part of daily living, so prohibiting an individual from driving could substantially impair their employment and quality of life.[20-22] We therefore conducted this study to provide objective, population-based evidence on the association of syncope with motor vehicle crashes. Our primary aim was to assess the risk of motor vehicle crashes among a nationwide cohort of patients with syncope. Our secondary aim was to examine the temporal relationship between syncope and subsequent motor vehicle crash risk.

Key Points

Question What is the association between prior syncope and motor vehicle crash risk?

Findings In this Danish nationwide cohort study of 41 039 patients with syncope, syncope was associated with a 2-fold increased risk of motor vehicle crashes compared with the general population. The elevated risk persisted throughout the follow-up period of 5 years.

Meaning The study suggests that patients with syncope are at increased risk of motor vehicle crashes, but as the absolute risk was relatively small, syncope should be considered as one of several factors in a broad assessment of fitness to drive rather than an absolute criterion.

Methods

Setting

This study was conducted from January 1, 2008, to December 31, 2012, in Denmark, where the health care is based on a tax-financed system that provides all inhabitants with equal access free of personal charge. The minimum age for obtaining driving permission is 18 years, and at age 70 years, all patients undergo mandatory driving license screening by their primary care physician.

Registers

In this nationwide study, we used a register-based follow-up design. At the time of birth or immigration, all individuals are given a unique and permanent civil registration number that enables individual-level linkage between nationwide administrative registers holding information on health care use.

Information about medical history and hospital contacts was retrieved from the Danish National Patient Register, which holds information about all hospitalizations since 1977.[23] At discharge, each hospitalization is coded with a primary diagnosis and, if appropriate, secondary diagnoses, based on the *International Classification of Diseases* (*ICD*). Since 2008, the National Patient Register also holds information about hospitalizations due to motor vehicle crashes, coded according to the Nordic Medico-Statistical Committee's classification of External Causes of Injuries,[24,25] which was used to identify all nonfatal crashes. We retrieved information about fatal crashes from the Cause of Death Register.[26] Medical history was broadened with information about dispensed prescriptions that has been consecutively registered according to the Anatomical Therapeutic Chemical classification system in the Danish Register of Medicinal Product Statistics.[27] Finally, average income in a 5-year period before inclusion was used as a proxy for socioeconomic status, as done previously.[28,29] We obtained information on vital status, sex, date of birth, and migration from the National Population Register.[30]

Study Population

The study population comprised all Danish residents between 2008 and 2012 who were at least 18 years old. We then identified a cohort including all patients discharged with a first-time primary diagnosis of syncope from hospital or emergency department (*International Classification of Diseases, Tenth Revision* [*ICD-10*] code R55.9). The discharge diagnosis of R55.9 has a positive predictive value of 95% and a sensitivity of 63%.[31]

Individuals were followed up until the first of the following occurrences: event of interest, emigration, death, or end of follow-up on December 31, 2012.

Comorbidity and Pharmacotherapy

We considered the following covariates as potential confounders based on current knowledge and literature: cardiovascular comorbidities, diabetes, cardiac pacemaker, implantable cardioverter-defibrillator, use of anxiolytic or antipsychotic drugs, and alcohol abuse,[7,16,32-37] and we retrieved information from discharge, prescription, or surgical procedure codes (eTable 1 in the Supplement). Individuals were considered to have cardiovascular disease if they had a diagnosis code for

either ischemic heart disease, cardiac arrhythmia, heart failure, atrioventricular block, left bundle branch block, cerebral vascular disease, or peripheral vascular disease. We considered claimed prescriptions for anxiolytics or antipsychotics up to 180 days prior to inclusion as use of these agents. Recurrent syncope was defined as the second discharge diagnosis (emergency department or inpatient) of syncope.

Outcome

The primary outcome was the first motor vehicle crash that was either fatal or sufficiently severe to require evaluation in an emergency department or admission to a hospital. We included crashes that involved motorized vehicles (cars, motorcycles, and vans), for which sensitivities above 87% and positive predictive values above 92% previously have been found.[25] We considered a nonfatal crash within 30 days prior to a fatal crash as a fatal crash. In addition, we considered crashes documented 48 hours before or after the time of the syncope hospitalization to be related to the syncopal event.

Statistical Analysis

We analyzed syncope in a time-dependent approach, so that individuals contributed to at-risk time in the general population until the date of a first-time hospitalization for syncope (syncope population). Baseline characteristics are therefore presented at time of inclusion for the general population and, correspondingly, at time of syncope hospitalization for the syncope population. Crude incidence rates were calculated as number of events per 1000 person-years at risk. We used multivariate Poisson regression analyses to examine incidence rate ratios (RRs) of motor vehicle crashes with 95% CIs following syncope compared with the general Danish population. We used the Lexis diagram to split the follow-up enabling continuous update of time-dependent covariates (ie, age, comorbidity, pharmacotherapy, and calendar year), and it included 3 time scales: calendar time, age, and follow-up. The Lexis diagram allows individuals to contribute to person-years to both unexposed and exposed groups by splitting each study individuals into several observations, one for each status defined by the time-dependent variable.

We constructed 2 Poisson models, both of which were adjusted for age, sex, calendar year, socioeconomic status, and the covariates listed in **Table 1**. In the first model, we included syncope as a time-dependent covariate to establish the RRs for subsequent motor vehicle crashes. In the second model, we further examined whether crash risk changed with time elapsed from syncope discharge by assessing risk at 1, 3, 6, and 12 months and every 12 months thereafter. To evaluate effect modification, relevant covariates, including age, sex, and cardiovascular disease, were selected a priori based on clinical relevance. Second, we examined the interactions by inclusion of interaction terms in the overall model using the likelihood ratio test, and if suitable, we presented the models stratified accordingly. A 2-sided $P < .05$ was considered statistically significant. All analyses were tested for validity in terms of constant RRs for each time period by performing the same analyses on a more frequent time scale.

Table 1. Characteristics of the Study Population

Characteristic	Study Population, No. (%)	
	Syncope (n = 41 039)	General Population (n = 4 224 262)
Age, median (IQR), y	66 (47-78)	45 (30-61)
Age group, y		
18-35	6838 (16.7)	1 442 515 (34.2)
36-69	18 962 (46.2)	2 227 465 (52.7)
≥70	15 239 (37.1)	554 282 (13.1)
Women	20 916 (51.0)	2 135 502 (50.5)
Men	20 123 (49.0)	2 088 760 (49.5)
Socioeconomic status (income), quartile		
<First	4776 (11.6)	843 504 (20.0)
First to third	30 467 (74.2)	2 520 885 (59.7)
>Third	5796 (14.1)	859 873 (20.3)
Cardiovascular disease	14 300 (34.8)	415 647 (9.8)
Ischemic heart disease	7137 (17.4)	190 891 (4.5)
Cardiac arrhythmias	5504 (13.4)	134 142 (3.2)
Cerebrovascular disease	4872 (11.9)	114 628 (2.7)
Heart failure	3251 (7.9)	62 806 (1.5)
Atrioventricular block and LBBB[a]	647 (1.6)	9898 (0.2)
Cardiac pacemaker	884 (2.2)	12 795 (0.3)
Implantable cardioverter-defibrillator	267 (0.7)	2385 (0.1)
Diabetes	4530 (11.0)	172 587 (4.1)
Alcohol abuse	2726 (6.6)	93 645 (2.2)
Anxiolytics	10 729 (26.1)	308 690 (7.3)
Antipsychotics	2807 (6.8)	78 274 (1.9)
Hospital admission type for syncope		
Inpatient	25 402 (61.9)	NA
Emergency department	15 637 (38.1)	NA
Follow-up, median (IQR), y	2.0 (2.5)	5.0 (0)

Abbreviations: IQR, interquartile range (quartile 1 to quartile 3); LBBB, left bundle branch block; NA, not applicable.

[a] First-, second-, or third-degree atrioventricular block.

Additional analysis was performed with risk-set matching to construct cumulative incidence proportion curves to illustrate absolute motor vehicle crash risk following syncope. Thus the syncope population was included on date of syncope hospitalization and thereafter matched with 2 controls from the general population by age and sex. Cumulative incidence was assessed using a competing risk model to account for the competing risk of death from other causes than fatal crashes in the syncope population.[38] The matched population was used to calculate cumulative incidence only.

Finally, we undertook sensitivity analyses and investigated fatal crashes, hospital admission type for syncope, and the influence of recurrent syncope on motor vehicle crash risk following syncope.

Statistical analyses were performed using SAS software, version 9.4 (SAS Institute Inc) and R 3.2.2. (R Foundation for Statistical Computing).

Ethics

This study was approved by the Danish Data Protection Agency. In Denmark, ethical approval is not required for register-based studies.

Results

Between 2008 through 2012, we identified 4 265 301 Danish residents who were 18 years or older, of whom 41 039 had a first-time diagnosis of syncope from hospital or emergency department. Patients with syncope had a median age of 66 (interquartile range [IQR] 47-78) years; 51.0% were women; and 34.8% had cardiovascular disease (Table 1). During a median follow-up of 2.0 (IQR 0.8-3.3) years, a total of 1791 patients with syncope (4.4%) experienced a motor vehicle crash that required medical evaluation in an emergency department or hospital; 0.3% of these crashes were fatal, and 78.1% resulted in crash-related injury. These 1791 crashes were a minority (0.8%) of the national total of 226 078, and the 6 fatalities were also a minority (0.8%) of the national total of 713 (**Table 2**). The average interval between syncope discharge and the occurrence of a crash was 315 (IQR 59-698) days.

The crude incidence rates of motor vehicle crashes per 1000 person-years were higher among the syncope population (20.6; 95% CI, 19.7-21.6) compared with the general population (12.1; 95% CI, 12.0-12.1). The crash rates were highest among the population aged 18 to 35 years and lowest among the population aged 70 years or older (**Figure 1**).

In multivariate analyses, which adjusted for age, sex, and calendar year, patients with syncope had a 2-fold higher RR of motor vehicle crashes compared with the general population (RR, 2.04; 95% CI, 1.95-2.14; $P < .001$]). We found that men had relatively increased crash risk compared with women: RR, 1.91 (95% CI, 1.79-2.03) vs RR, 1.74 (95% CI, 1.63-1.87). The fully adjusted RRs of motor vehicle crash risk increased with age among men but decreased with age among women ($P < .001$ for the interaction) (Figure 1).

The excess risk of motor vehicle crashes among patients with syncope persisted throughout the follow-up of 5 years (**Figure 2**), with similar results in all age groups and regardless of recurrent syncope (eFigure 1 in the Supplement). Furthermore, the 5-year cumulative incidence for motor vehicle crashes remained significantly elevated among patients with syncope in a competing risk model that accounted for death from other causes, particularly in the population aged 18 to 69 years in which the risk was 8.2% (**Figure 3**).

Table 2. Motor Vehicle Crashes in Individuals With Syncope and in the General Population

Motor Vehicle Crash Characteristics	Study Population, No. (%)	
	Syncope (n = 41 039)	General Population (n = 4 224 262)
Total[a]	**1791 (4.4)**	**224 287 (5.3)**
Fatal	6 (0.3)	707 (0.3)
Nonfatal	1785 (99.7)	223 580 (99.7)
Crash-related injury		
Any	1398 (78.1)	193 194 (86.1)
Superficial[b]	974 (54.4)	140 924 (62.8)
Major[c]	424 (23.7)	52 270 (23.3)
Crash with syncope episode[d]	349 (19.5)	NA

Abbreviation: NA, not applicable.

[a] Median follow-up was 2.0 years for the syncope population and 5.0 years for the general population.

[b] Superficial injury defined as superficial lesion, wound, or sprain.

[c] Major injury defined as fracture, traumatic amputation, crush lesion, internal lesion, or internal bleeding.

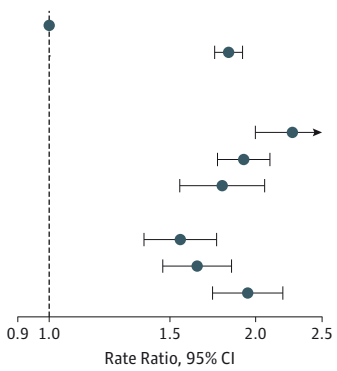
[d] Motor vehicle crash in immediate relation to syncope.

Sensitivity and Subgroup Analyses

In subpopulations with and without cardiovascular disease, we found that the RRs of motor vehicle crashes were lower among patients with syncope who also had cardiovascular disease than those without cardiovascular disease (eFigure 2 in the Supplement). In addition, among a subgroup of patients with syncope with an implantable cardioverter-defibrillator, syncope was not significantly associated with motor vehicle crashes (eTable 2 in the Supplement). In contrast, we found that patients with recurrent syncope had a motor vehicle crash risk similar to patients with only a single hospitalization for syncope (eFigure 3 in the Supplement).

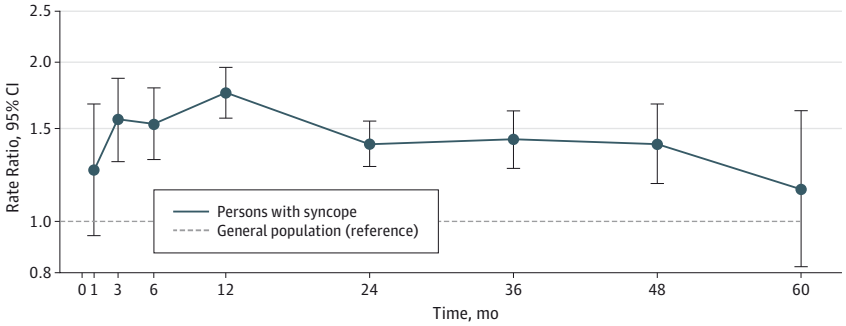
Figure 1. Motor Vehicle Crash Risk Following Syncope by Age and Sex

	Events, No.	IR per 1000 PY (95% CI)	Rate ratios (95% CI)	*P* Value
General population	224 287	12.1 (12.0-12.1)	1 [Reference]	
Syncope	1791	20.6 (19.7-21.6)	1.83 (1.74-1.91)	<.001
Age groups, y				
Men				
≥70	261	16.5 (14.6-18.6)	2.26 (2.00-2.56)	<.001
36-69	505	23.7 (21.7-25.9)	1.92 (1.76-2.10)	<.001
18-35	190	42.8 (37.1-49.3)	1.79 (1.55-2.06)	<.001
Women				
≥70	265	13.6 (12.1-15.3)	1.55 (1.38-1.75)	<.001
36-69	291	16.6 (14.8-18.6)	1.64 (1.46-1.85)	<.001
18-35	279	33.8 (30.1-38.1)	1.95 (1.73-2.19)	<.001



Poisson regression model with the general Danish population as reference, with adjustment for sex, cardiovascular disease, cardiac pacemaker, implantable cardioverter-defibrillator, diabetes, alcohol abuse, use of anxiolytics or antipsychotics, socioeconomic status, and calendar year and stratified by age. IR indicates incidence rate; PY, person-years.

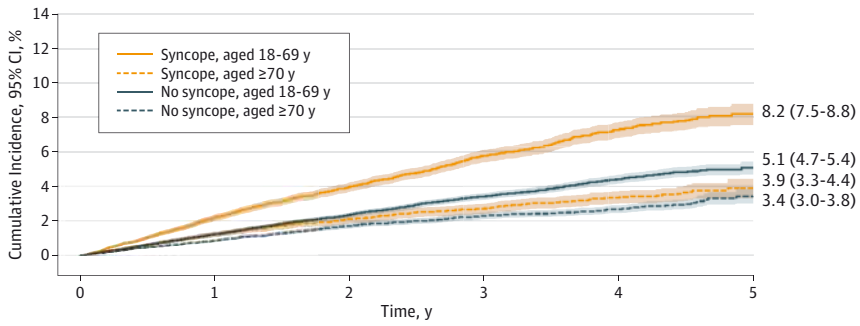
Figure 2. Time Elapsed From Syncope and Risk of Motor Vehicle Crashes



Months	0-1	1-3	3-6	6-12	12-24	24-36	36-48	48-60
Events, No.	47	114	158	317	391	252	130	33
PY	3277.9	6350.5	8948.2	15739.4	24603.5	16179.7	8963.8	2816.4
RR	1.25	1.56	1.53	1.75	1.40	1.43	1.40	1.15
95% CI	0.94-1.67	1.30-1.87	1.31-1.79	1.57-1.96	1.27-1.55	1.26-1.62	1.18-1.67	0.82-1.62
P Value	.13	<.001	<.001	<.001	<.001	<.001	<.001	.41

Poisson regression model with the general Danish population as reference, with adjustment for age, sex, socioeconomic status, calendar year, cardiac pacemaker, implantable cardioverter-defibrillator, cardiovascular disease, diabetes, alcohol abuse, and use of anxiolytics or antipsychotics. Crash events per person-year (PY) are reported for the syncope population. RR indicates rate ratio.

Figure 3. Elevated Cumulative Incidence for Motor Vehicle Crashes Following Syncope



No. at Risk						
Syncope, aged 18-69 y	23654	17765	12748	7983	3827	13
Syncope, aged ≥70 y	17151	11427	7638	4509	1973	4
No syncope, aged 18-69 y	46650	36885	26927	17205	8340	27
No syncope, aged ≥70 y	33368	24788	16921	10262	4623	7

Illustrated incidence is compared with an age- and sex-matched control population, accounting for competing risk of death from other causes.

The RRs of fatal crashes were similar to risk estimates for overall motor vehicle crashes, but the incidence rates were significantly lower (eFigure 4 in the Supplement). Patients with syncope who were discharged from emergency departments were younger, had less comorbidity (eTable 3 in the Supplement), and were associated with higher crash risk compared with inpatients (eFigure 5 in the Supplement).

Discussion

In this nationwide study of more than 4.2 million individuals, we found that first-time syncope was associated with a 2-fold increased risk of motor vehicle crashes that remained elevated throughout follow-up. Because to our knowledge, no previous large-scale study has investigated syncope and traffic safety, these data provide novel information for development of policies about syncope and driving.

We found that excess crash risk following syncope was consistent, although the degree of excess risk varied according to age, sex, and comorbidity. Our findings of higher crash rates among the younger age groups and men are in line with current evidence: men drive more and are more likely to engage in risk-taking behavior such as speeding, failure to use seat belt, and driving while intoxicated.[10,39-42] Medical screening as a condition for relicensing in the older drivers may lead to lower crash rates among the elderly population.[43] In addition, older persons are more likely to be severely injured or die in motor vehicle crashes because of increased fragility and be more likely to need hospital evaluation compared with younger persons.[44] Self-imposed behavioral restrictions, such as avoidance of driving in bad weather, at night, or during high-traffic periods, are common among older drivers and may lead to lower risk of motor vehicle crashes.[45,46] Several studies suggest that women are more likely to self-regulate or cease their driving, which could explain the different trends by age for older men and women found in the current study.[45-49]

Only a small proportion of the patients with syncope in this study experienced a motor vehicle crash in immediate relation to index syncope. Acute illness is difficult to assess in motor vehicle crashes because it can be masked by severe injury, so we chose to analyze the relation of syncope with subsequent motor vehicle crashes in a time-to-event approach. Our finding of a 2.2% crash risk in the first year following syncope

is lower than 3.4% among participants in the AVID trial[50] (secondary prevention implantable cardioverter-defibrillator patients). In the MADIT-RIT trial[51] (primary prevention implantable cardioverter-defibrillator patients), 3.1% of the study population had syncope while driving during 1.4 years of follow-up.

Another novel finding in the present study was that the motor vehicle crash risk following syncope remained elevated throughout the follow-up period. Several factors might contribute to this sustained risk. First, it is likely that syncope is a marker for a more severely sick population, with more cardiovascular and other comorbidities, who are receiving medical therapy that could influence risk of syncope as well as the motor vehicle crash risk.[3,32,34-36] We hypothesized that cardiovascular disease would be associated with higher crash risk because it is likely to cause syncope with little or no warning and has been identified as an independent predictor of syncope while driving.[11] Our findings suggest, however, the opposite was true—namely, that presence of cardiovascular disease was associated with a relatively lower risk. A plausible explanation could be that more serious cases of cardiac syncope receive diagnoses of specific cardiac causes rather than the *ICD-10* diagnosis of syncope.[31] It is also likely that these individuals were subject to driving restrictions imposed by the underlying cardiovascular conditions rather than the syncope per se.[6] This would be in line with our findings from the syncope subpopulation with implantable cardioverter-defibrillators.[33]

Information about syncope cause was unavailable in the current study. Several studies have identified reflex syncope (eg, vasovagal syncope caused by orthostatic stress) as the most common type of syncope while driving.[11,14,15,52] Current guideline recommendations place no driving restrictions on patients with reflex syncope.[1,16]

Recurrence rates for syncope are relatively high and remain high for several years.[1,4,5] Although most guidelines recommend some form of abstinence from driving after recurrent syncope,[1,16] we did not find a reduced crash risk among patients with recurrent syncope. However, it is possible that patients resumed driving whether or not they were advised by their physician not to do so.[13,50,53] Also, as we defined recurrent syncope as a second hospital discharge of syncope, it is possible that recurrence occurred without subsequent hospitalization.

The main advantage of our study is the large cohort of patients with syncope with complete follow-up that enabled us to investigate relatively rare crash events accurately. This study also included data on fatal crashes.

The study has several potential limitations. First, it was based on observational data and therefore lacks clinical information on the cause of syncope, so risk estimates for individual causes remain unknown. However, the *ICD-10* code R55.9 is representative for the most common causes of syncope, and despite thorough investigation, the cause of the syncope remains unexplained in 20% to 30% of cases.[54,55] One-third of those hospitalized for syncope receive other more specific discharge diagnoses, such as ventricular arrhythmia, aortic valve stenosis, and atrioventricular block.[31] In addition, only a smaller but probably selected proportion of individuals with syncope contact the emergency department or hospital,[56] but it is unknown in what direction this would influence crash risk.

Second, data regarding the circumstances of the traffic crash were unavailable, including use of alcohol or illicit drugs, use of seat belts, among other traffic conditions. We accounted for alcohol abuse[57] because it is a risk factor of crashes, but we acknowledge that use of alcohol and other substances in relation to the crash events were unmeasured in the present study and could have influenced crash risk particularly among the younger population.[37,40-42]

Third, exposure to driving, driver status, and driving license were unavailable for the current study. In Denmark, 87% of the population 18 years or older have a driving license,[39] but the elderly population may self-regulate or cease driving, as might persons with other medical conditions with policies on driving.[16,19,33] Private and commercial driving was not considered separately because this information was unavailable.[1,16,19]

Fourth, information about crashes was obtained from hospitals' traffic crash registration; thus, it is possible that we have overestimated the proportion and severity of crash-related injuries. Conversely, it is likely that we have underestimated the rate and consequences of crashes because we did not include multiple events and had no data about minor crashes that did not require medical evaluation or led to evaluation in the offices of a general practitioner. Furthermore, we could not evaluate whether other individuals were also injured in the crash along with the patient with syncope, nor do we have any data on crashes that injured others, such as pedestrians, but did not injure the patient with syncope.

Conclusions

While much remains unknown about syncope and traffic safety, our findings suggest that patients with syncope are at increased risk of motor vehicle crashes compared with the general population. Since the absolute crash risk was relatively small, whether syncope should lead to restrictions on a patient's ability to drive is a difficult policy question that must balance multiple considerations. Syncope should be considered as one of several factors in a broad assessment of fitness to drive rather than an absolute criterion. We urge increased physician awareness about driving recommendations, accurate diagnosis, and appropriate treatment for patients with syncope to reduce motor vehicle crashes.

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Drafting of the manuscript: Numé.
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Study supervision: Gislason, Hlatky, Ruwald.

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Invited Commentary

Syncope and the Risk of a Subsequent Motor Vehicle Crash

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A 44-year-old man was driving northbound along Interstate I-81 in Pennsylvania under clear sunny skies in the mid-afternoon on Wednesday, November 25, 2015 (the day before the Thanksgiving holiday).[1] He fell unconscious, crossed a grassy median, and crashed into an oncoming tractor-trailer truck. He died instantly, as did his 12-year-old child passenger. This case is not unique and now becomes one more anonymized statistic among the 90 traffic fatalities that occur on an average day in the United States.[2] About a third involve drivers known to have an underlying medical illness such as a cardiac, neurologic, or psychiatric disorder.[3] Almost all of these drivers visit a physician in the year before their motor vehicle crash.[3]

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Numé et al[4] in this issue provide a rigorous analysis of 41 039 adults diagnosed with syncope and followed for a median of 2 years. The primary outcome was a serious motor vehicle crash, defined as an event sending a patient to the hospital (not necessarily admitted). The main findings suggest a doubling of risk relative to the population norm, equal to an absolute rate of about 1 serious motor vehicle crash per 50 patients with syncope annually. The increased risk extended for up to 5 years of follow-up and was particularly high for older men. The research is distinctive because syncope was based on International Classification of Diseases codes that excluded cases of third-degree heart block, epileptic convulsions, carotid sinus dysfunction, or orthostatic hypotension.

These findings are consistent with past research suggesting that syncope leads to a significant increase in the risk of a motor vehicle crash. A population-based study from Maryland (n = 7750) suggests that patients with syncope have about quadruple the crash risk of the population norm.[5] A population-based study from Canada (n = 25 422) suggests that patients with syncope have about triple the crash risk of the population norm.[6] A clinical trial from the United States (n = 559) sug-