



ORIGINAL ARTICLE

# Obstructive sleep apnea and risk of suicide and self-harm: a Danish Nationwide Cohort Study

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## Abstract

**Study Objectives:** In this nationwide study, we used the unique Danish registries to estimate the risk of suicide and deliberate self-harm in patients with obstructive sleep apnea (OSA).

**Methods:** We identified all Danish citizens receiving a diagnosis of OSA between 1995 and 2015. As a reference cohort, we randomly selected 10 citizens for each patient, matched by sex and birth year. Using the Fine and Gray competing risk regression, we estimated the cumulative incidences of suicide, and Cox proportional regression analysis was used to compare the risk of suicide and deliberate self-harm in patients with OSA with the reference cohort.

**Results:** We identified 48 168 patients with OSA. A total of 135 patients had died by suicide, compared with 999 suicides in the reference cohort. Patients with OSA had an increased risk of dying by suicide when compared with the reference cohort (hazard ratio, 1.29; 95% CI = 1.07% to 1.55%; and subhazard ratio, 1.23; 95% CI = 1.10% to 1.45%). We identified 1004 events of self-harm among patients with OSA, and 5270 events in the reference group. The overall risk of self-harm was increased in patients with OSA when compared with the reference group (hazard ratio, 1.28; 95% CI = 1.19% to 1.37%).

**Conclusions:** This is the first study to estimate the risk of suicide and deliberate self-harm in patients with OSA. We found that patients with OSA have an increased risk of both suicide and deliberate self-harm when compared with a large reference cohort, thereby highlighting the importance of a mental health screening in these patients.

## Statement of Significance

Suicide is a serious public health problem and one of the leading causes of death. In this nationwide study, we have for the first time established that patients with obstructive sleep apnea have an increased risk of suicide and deliberate self-harm when compared to a large reference cohort. As such, we believe that there must be a larger focus on mental health in the evaluation of these patients. We hope that by bringing awareness to an increased risk of this fatal outcome, our novel finding will assist physicians providing care for patients with obstructive sleep apnea.

**Key words:** obstructive sleep apnea; sleep apnea; sleep disorders; epidemiology; psychiatry; suicide; mental health

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## Introduction

Approximately 800 000 people die by suicide every year worldwide [1, 2]. In Denmark, a country with 5.8 million inhabitants, around 600 people die by suicide every year—a number three times higher than the number of people who die in car accidents. Suicidal behavior has consistently been linked to mental illness; however, several somatic disorders is also correlated with suicide deaths [3, 4]. Obstructive sleep apnea (OSA) is a very common disease, affecting approximately 25% of adults in the United States, with similar incidences in other western countries [5, 6]. OSA have shown to increase the risk of various organic diseases, including cardiovascular disease, stroke, and diabetes [7–10]. In recent years, OSA have been associated with an impact on mental health, as reports have shown a higher risk of depression in this population [11]. Indeed, OSA, and sleep disturbances in general, have been shown to be associated with various psychiatric illness, including suicidal ideation and self-harm [12–19]. The risk of suicide and deliberate self-harm have never, nonetheless, been investigated in the OSA population. In this present study, we used the unique Danish registers to estimate the risk of suicide and self-harm in a nationwide cohort of patients with OSA, covering up to 25 years of follow-up.

## Methods

### Study population

We used several medical registries in this nationwide descriptive cohort study (see overview in Figure 1). Registration and collection of data from all hospitals and outpatient clinics in Denmark is mandatory, with linkage of different registers made possible by the use of the unique personal identification number, the civil registration number, assigned to all Danish individuals at birth or immigration [20]. The Danish healthcare system is publicly financed, with equal accessibility for all registered Danish residents. We used the Danish National Patient Registry (DNPR) to identify all Danish citizens older than 15 years of age receiving a diagnosis of OSA between 1995 and 2015 [21]. The DNPR contains information on all hospital admissions in Denmark, dates of admission and discharge, surgical procedures, and discharge diagnoses coded according to the International Classification of Diseases, Tenth Revision (ICD-10). To identify patients with OSA, we used the ICD-10 codes DG473 and DG4732. To identify the patients with OSA treated with continuous positive airway pressure (CPAP), we used the code ZZ3915. As adjusting covariates, we used Denmark's Statistics to get information on Socio-Economic Classification from The Employment Classification Module for both patients with OSA and the comparison cohort based on information on the main source of income and employment for each individual. A random reference sample matched by sex and birth year with the included patients with OSA was drawn using the Danish Civil Registration System, ensuring a ratio of 10 citizens per patient. To eliminate the risk of immortal time bias, date of diagnosis was used as the date of matching between patients with OSA and their references.

### Assessment of suicide and self-harm

We linked the study population with the Danish Register of Causes of Death using the civil registration number, to obtain

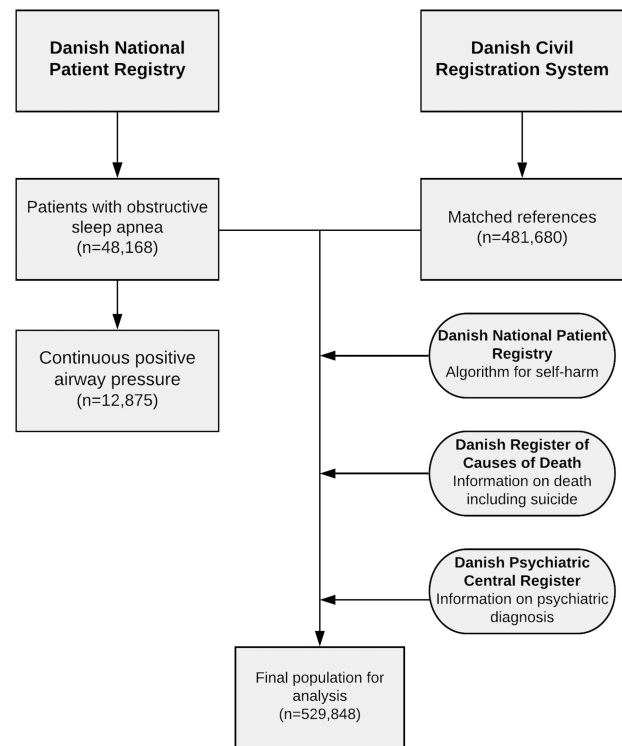


Figure 1. Overview of data sources.

any information of suicide (using the codes X60–X84 from the ICD-10 classification) and date of suicide, if any [22]. This register contains information on all deaths in Denmark from 1970 to 2019. The legal regulation of death certification in Denmark states that any case of sudden and unexpected death, thereby including suicide, must be reported to the police. In these cases, the death certificate will only be completed after a medicolegal examination. We also linked the study population with the Danish Psychiatric Central Register to obtain information about deliberate self-harm [23]. This register contains data on all admissions to Danish psychiatric inpatient facilities from 1969, whereas data on outpatient visits to psychiatric departments were included from 1995. We identified deliberate self-harm as individuals fulfilling at least one of the following five criteria in the DNPR or Danish Psychiatric Central Register: (1) *reason for contact* code 4, (2) any psychiatric diagnosis (ICD-10 chapter F) and a comorbid diagnosis of poisoning with medication and biological compounds (ICD-10 codes T36 through T50) or nonmedical compounds, excluding alcohol and poisoning from food (T52 through T60), (3) any psychiatric disorder (ICD-10 chapter F) and comorbid diagnosis reflecting lesions on the forearm, wrist, or hand (ICD-10 codes S51, S55, S59, S61, S65, or S69), (4) any contact with a hospital because of poisoning with weak or strong analgesics, hypnotics, sedatives, psychoactive drugs, antiepileptics, and antiparkinsonian drugs or carbon monoxide (ICD-10 codes T39, T42, T43, and T58), and (5) any somatic or psychiatric diagnosis X60 through X84. This algorithm of deliberate self-harm has been described in previous studies [4, 24].

### Statistical analysis

Categorical baseline variables were summarized by percentages or frequencies. Comparisons of categorical characteristics

between patients and the reference cohort were performed by Fisher's exact test. Similarly, continuous baseline variables were reported as mean and standard deviation (SD). Comparisons of means were performed by unpaired t test.

We followed patients with OSA from their first hospital contact, inpatient or outpatient, with OSA until suicide, death from other causes, or December 31, 2020 (whichever came first). Comparisons of incidences of suicide/first episode of self-harm between patients with OSA and their matched references were performed in our main analysis by Cox regression with age as time scale. In each matching cluster, individuals entered the risk set at the age of diagnosis of the patient with OSA. SEs were calculated taking matching clusters into account. The cause-specific hazard ratio is supplied with the subhazard ratio, with death by other causes being the competing risk, as suggested by Latouche et al [25]. Through the matching and choice of time scale, the analyses are adjusted for sex, attained age, and birth year. Furthermore, we adjusted for socioeconomic status. We estimated the cumulative incidences of suicide in patients with OSA and compared them with the reference cohort using the Fine and Gray competing risk regression [26]. To illustrate the time variations of incidents rates, smoothed cause-specific hazard estimates are presented for patients and references. Comparison between patients with OSA treated with and without CPAP were additionally adjusted for age and sex. Additionally, a subanalysis was made comparing the risk of self-harm between patients diagnosed with OSA before or after 40 years of age. Finally, we used Poisson regression to calculate the incidence rate ratio (IRR) for suicide and all self-harm episodes (as one person can commit multiple events) in patients with OSA and the reference cohort. Statistical significances were defined as those with *p*-values below 0.05. All analyses were performed using Stata 16 (StataCorp LP, TX). This study was approved by The Central Denmark Region Research Committee (1-16-02- 558- 20). The requirement for informed consent was waived given the nature of the study.

## Results

The Danish cohort of patients with OSA diagnosed between 1995 and 2015 is composed of 48 168 patients (mean age, 64 years; 78% male). Baseline characteristics are presented in Table 1.

**Table 1.** Characteristics of patients with OSA and matched references

Variable	Cases n = 48 168	References n = 481 680	P
Age, year, mean (SD)	64.2 (13)	64.2 (13)	0.9681
Sex, male (%)	77.7	77.7	—
Age at diagnosis, years, mean (SD)	53.5 (12.9)	—	—
Follow-up, y (min-max)	12.5 (4-25)	—	—
CPAP, n (%)	12 875 (26.7)	—	—
Dead, n (%)	7009 (14.6)	64 515 (13.4)	<0.0001
Age at death, years, mean (SD)	69.4 (11.3)	70 (10.7)	<0.0001
Socioeconomic status			
-Owner of business or employee with high income, n (%)	4870 (10.1)	64 654 (13.4)	<0.0001
-Employee with middle or low income, n (%)	12 901 (26.8)	129 499 (26.9)	0.635
-Unemployed, social benefits, students or pensioners, n (%)	28,887 (60.0)	255,164 (53.0)	<0.0001
-Other, n (%)	1326 (2.8)	30,077 (6.2)	<0.0001
-Missing, n (%)	184 (0.4)	2286 (0.5)	0.004
Comorbidity			
-Diabetes Mellitus, n (%)	5748 (11.9)	22 172 (4.6)	<0.0001
-Hypertension, n (%)	5913 (12.3)	26 284 (5.5)	<0.0001
-Cerebrovascular events, n (%)	3736 (7.8)	26 165 (5.4)	<0.0001

Among patients with OSA, 7009 (14.6%) had died with a median age of death of 69 years, compared with 64 515 (13.4%) deaths in the reference cohort. Mean follow-up was 12.5 years, with a maximum follow-up of 25 years. The reference cohort was composed of 481 680 individuals from the general population (mean age, 64 years; 78% male).

### Risk of suicide

A total of 135 patients with OSA (1.93% of all deaths; median age at suicide, 57 years) had died by suicide, compared with 999 suicides (1.55% of all deaths; median age at suicide, 59 years) in the reference cohort. Patients with OSA had a significantly increased risk of dying by suicide when compared with the reference cohort (hazard ratio, 1.29; 95% CI, 1.07–1.55; and subhazard ratio, 1.23; 95% CI = 1.10% to 1.45%) (see Table 2). In Figure 2, the cumulative incidence of suicide by time since the OSA diagnosis is shown, demonstrating a clear difference between patients and references. The smoothed cause-specific hazard estimates illustrate the occurrence of suicide in patients with OSA compared with the reference cohort (Figure 3). Additionally, the incidence rate ratios of suicide differed significantly between the two groups. There was a clear tendency to a higher occurrence of suicide among patients treated without CPAP (2.1%) compared with patients treated with CPAP (1.4%; *p* = .057), as shown in Table 3. This tendency is also reflected in the incidence rate ratio and hazard ratio when comparing the two groups.

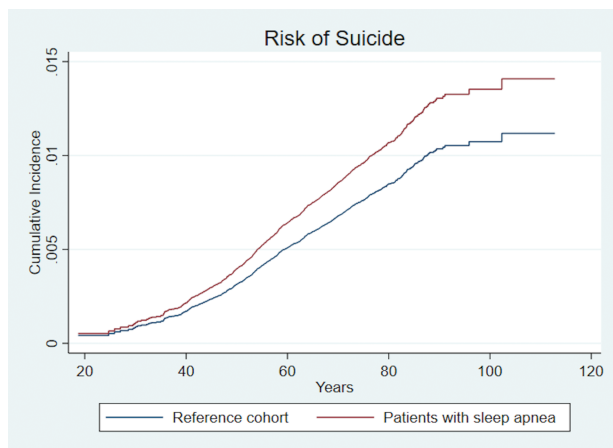
### Risk of self-harm

We identified 1004 events of self-harm among patients with OSA after time of diagnosis, and 5270 events in the reference group. For patients with OSA, the overall risk of deliberate self-harm was significantly increased when compared with the reference group (hazard ratio, 1.28; 95% CI = 1.19% to 1.37%; and subhazard ratio, 1.20; 95% CI = 1.08–1.33) when only including the incident event per individual (Table 2). The incidence rate ratio showed a clear difference between the two groups (IRR: 1.58; 1.52–1.64). A subanalysis demonstrated that the risk of self-harm was

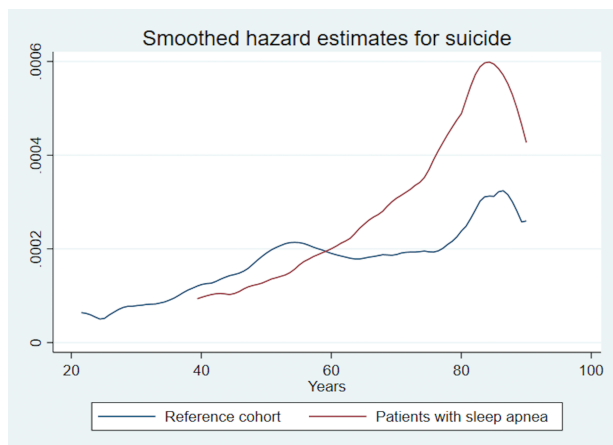
**Table 2.** Risk of suicide and self-harm in patients with OSA compared with matched references

Variable	No. of cases	SHR (95% CI)	HR (95% CI)	IRR (95% CI)
Suicide				
Patients with sleep apnea	135	1.23 (1.10–1.45)	1.29 (1.07–1.55)	1.34 (1.12–1.60)
Self-harm				
Patients with sleep apnea	1004	1.20 (1.08–1.33)	1.28 (1.19–1.37)	1.58 (1.52–1.64)

SHR = subhazard ratio; HR = hazard ratio; IRR = incidence rate ratio (all events).



**Figure 2.** Cumulative incidence of suicide by time of diagnosis among patients with OSA.



**Figure 3.** Smoothed cause-specific hazard estimate of suicide by time of diagnosis among patients with OSA.

similar regardless of patients being diagnosed with OSA before or after 40 years of life.

The occurrence of self-harm was higher in the patients with OSA treated without CPAP (2.4%) when compared with OSA patients treated with CPAP (1.2%;  $p < 0.001$ ), see [Table 3](#). The incidence rates were significantly higher in patients treated without CPAP; however, no differences were found when comparing incidence of first event of self-harm.

## Discussion

In this nationwide study, we estimated the risk of suicide and deliberate self-harm in patients with OSA covering a long-term

follow-up of up to 25 years. We have demonstrated that the absolute risk of both suicide and self-harm in patients with OSA is significantly higher when compared to the risk found in a large reference cohort. We also found that patients with OSA treated with CPAP had lower incidence rate of self-harm when compared to patients treated without CPAP.

Our data suggest the theoretical linkage between suicide and self-harm and OSA to be true, emphasizing the importance of sleep in the development of mental health issues. Our hypothesis was created by the fact, that sleep disorders, several major physical health conditions, and all psychiatric disorders are associated with increased risk of suicide [3, 4, 7, 19]. As mentioned previously, psychiatric conditions are significantly more prevalent in individuals with diagnosed OSA. Studies have shown that especially mood disorders (anxiety and depression) are common in patients with OSA—disorders that are heavily associated with increased risk of suicide [4, 11, 15, 27]. Additionally, OSA is associated with cardiovascular disease, eg. heart failure, which again is associated with increased risk of suicide [7, 28, 29]. As such, our findings were somewhat anticipated. Despite patients with OSA have several evidence-based risk factors for suicide, the poor late outcome demonstrated in the current study may reasonably be mainly attributed to the association with mood disorders. As a consequence, the clinical assessment of patients with OSA should include an evaluation of whether the patient would benefit from a psychiatric consultation to identify individuals at risk of suicide.

Although the risk of suicide and self-harm in patients with OSA had never been investigated before, there have been described an increased risk of suicide attempts, suicidal ideation, and planning [18, 30–32]. This association was highlighted in a study by Bishop et al, who demonstrated that insomnia and sleep-related breathing disorders, including OSA, were associated with suicide attempts among US veterans [32]. However, after adjusting for several psychiatric comorbidities and obesity, sleep-related breathing disorders were no longer positively associated with suicide attempt. This discrepancy in relation to our study might be explained by the differences in analysis plan or study design, given that Bishop et al had a retrospective approach, starting with the outcome (suicide attempts) and then traced back to investigate exposures.

Another study by Bishop et al demonstrated that patients with self-reported OSA were more likely to report suicidal thoughts and behavior, thereby supporting our findings [31]. In disagreement with our results, the authors report that suicide attempts were not associated with self-reported OSA. The authors suggest that they might lack power in their design to detect a difference as only 12 suicide was attempted among people with self-reported OSA. In contrast, the present study has sufficient power to detect even small differences, as well as a completely different design more suited for establishing a potential association. Another interesting explanatory suggestion by the authors is that patients with OSA might lack the mental or physical energy to act on their

**Table 3.** Characteristics of patients with OSA treated with or without CPAP and the risk of suicide and self-harm compared between the two groups

	CPAP n = 12,875	No CPAP n = 35,293	P
Dead, n (%)	1263 (9.8)	5746 (16.23)	<0.0001
Age at death, years, mean (SD)	69.5 (11.3)	69.4 (11.29)	0.813
Suicide, n (% of deaths)	17 (1.4)	118 (2.1)	0.057
Self-harm, n (%)*	144 (1.2)	860 (2.4)	<0.001
Variable	No. of cases	IRR	HR
Suicide	135	0.61 (0.36–1.02)	0.62 (0.37–1.04)
Self-harm	1004	0.71 (0.59–0.84)	0.93 (0.69–1.27)

HR = hazard ratio; IRR = incidence rate ratio.

\*Total number of events (one person can commit multiple events).

suicidal thoughts, ie, patients with OSA have poor executive function. Actual executive function, reflecting planning and execution, is found to be impaired in patients with OSA [33]. However, the correlation between executive function and suicide is more complex. In a systematic review, the authors could not make a clear conclusion on executive function and suicide based on the existing literature, whereas another paper actually indicated that poor executive function was associated with increased risk of suicidal behavior [34, 35]. That said, executive function in patients with OSA were not addressed in this study and a potential association with suicide in this patient group is unknown.

Patients with OSA treated with CPAP had a lower incidence ratio of deliberate self-harm, and, generally, there were a trend toward a lower incidence ratio and risk of both suicide and self-harm in these patients when compared to patients with OSA not receiving CPAP treatment. We must expect that the patients receiving CPAP treatment are the ones with moderate to severe OSA, whereas patients not receiving CPAP have mild OSA. While speculative, this finding indicates that patients with moderate to severe OSA treated with CPAP are less vulnerable than patients with mild OSA not receiving CPAP treatment, perhaps supporting the notion that even patients with mild OSA could benefit from CPAP treatment.

### Limitations

The validity of our estimates depends on the accuracy of the OSA diagnosis, which again depends on the physicians generating the data. The validity of the diagnosis in the DNPR is considered moderate to high. To strengthen the validity of our data further, we only chose to include patients with a primary diagnosis of OSA, and by only including patients diagnosed after 1995, the completeness of our cohort is higher as all patients diagnosed in an outpatient clinic is included.

Regarding external validity of our findings, we cannot extrapolate our findings to the large group of undiagnosed patients with OSA in the general population. Additionally, our cases are likely to suffer from clinical referral bias, given that many patients with OSA have other clinical conditions potentially associated with suicide and self-harm. This may consequently account for the significance of the association demonstrated in the present study.

Deliberate self-harm is, unfortunately, only correctly reported with a contact code 4 in 37% [36]. As a consequent, we decided to include codes covering methods often used for deliberate

self-harm. We are aware that this approach includes a risk of including some incidents with accidental harm. The chosen approach has, however, been validated as the best estimate for self-harm. As we used same approach for both cases and references, we believe that it would not influence the overall interpretation of our data.

Lastly, given the nature of the registries, we do not have detailed clinical information, eg, apnea-hypopnea index, mandibular advancement devices, or therapy adherence. Furthermore, we were not able to include potential important confounding lifestyle variables such as body mass index and smoking, as these variables are unavailable in central national registries. These variables are, however, partly incorporated as obesity and smoking are reflected by the socioeconomic status [37, 38].

### Conclusion

With this nationwide study, we are the first to estimate of risk of suicide and self-harm in patients diagnosed with OSA followed up from time of diagnosis. Our results suggest that patients diagnosed with OSA have a moderately increased risk of suicide and deliberate self-harm when compared with a large reference cohort. Although clinical referral bias may impact our results, our data indicate the importance of monitoring for psychiatric vulnerability and, hopefully, our results will assist physicians providing counseling for patients with OSA.

### Supplementary Material

Supplementary material is available at SLEEP online (see [supplementary figure 1](#))

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## Disclosure Statement

None declared.

## Data Availability

The data used in the present study are not publicly available, as it is necessary to obtain permission from Statistics Denmark.

## References

- Bachmann S. Epidemiology of suicide and the psychiatric perspective. *Int J Environ Res Public Health*. 2018;15(7):1425. doi:10.3390/ijerph15071425
- World Health Organization. *Suicide Worldwide in 2019: Global Health Estimates 2019*. <https://www.who.int/publications/item/9789240026643>
- Ahmedani BK, et al. Major physical health conditions and risk of suicide. *Am J Prev Med*. 2017;53(3):308–315.
- Nordentoft M, et al. Absolute risk of suicide after first hospital contact in mental disorder. *Arch Gen Psychiatry*. 2011;68(10):1058–1064.
- Young T, et al. Epidemiology of obstructive sleep apnea: a population health perspective. *Am J Respir Crit Care Med*. 2002;165(9):1217–1239.
- Punjabi NM. The epidemiology of adult obstructive sleep apnea. *Proc Am Thorac Soc*. 2008;5(2):136–143.
- Floras JS. Sleep apnea and cardiovascular disease: an enigmatic risk factor. *Circ Res*. 2018;122(12):1741–1764.
- Bassetti CLA, et al. EAN/ERS/ESO/ESRS statement on the impact of sleep disorders on risk and outcome of stroke. *Eur J Neurol*. 2020;27(7):1117–1136.
- Ponsaing LB, et al. Impaired cerebrovascular reactivity in obstructive sleep apnea: a case-control study. *Sleep Med*. 2018;43:7–13.
- Kohli P, et al. Obstructive sleep apnea and the risk for cardiovascular disease. *Curr Atheroscler Rep*. 2011;13(2):138–146.
- Hobzova M, et al. Depression and obstructive sleep apnea. *Neuro Endocrinol Lett*. 2017;38(5):343–352.
- Carli V, et al. A newly identified group of adolescents at “invisible” risk for psychopathology and suicidal behavior: findings from the SEYLE study. *World Psychiatry*. 2014;13(1):78–86.
- Tseng WC, et al. Sleep apnea may be associated with suicidal ideation in adolescents. *Eur Child Adolesc Psychiatry*. 2019;28(5):635–643.
- Rod NH, et al. Sleep apnea, disability pensions, and cause-specific mortality: a Swedish Nationwide Register Linkage Study. *Am J Epidemiol*. 2017;186(6):709–718.
- Kaufmann CN, et al. Sleep apnea, psychopathology, and mental health care. *Sleep Health*. 2017;3(4):244–249.
- Goldstein TR, et al. Sleep disturbance preceding completed suicide in adolescents. *J Consult Clin Psychol*. 2008;76(1):84–91.
- Wojnar M, et al. Sleep problems and suicidality in the National Comorbidity Survey Replication. *J Psychiatr Res*. 2009;43(5):526–531.
- Choi SJ, et al. Suicidal ideation and insomnia symptoms in subjects with obstructive sleep apnea syndrome. *Sleep Med*. 2015;16(9):1146–1150.
- Bernert RA, et al. Suicidality and sleep disturbances. *Sleep*. 2005;28(9):1135–1141. doi:10.1093/sleep/28.9.1135
- Schmidt M, et al. The Danish Civil Registration System as a tool in epidemiology. *Eur J Epidemiol*. 2014;29(8):541–549.
- Lynge E, et al. The Danish national patient register. *Scand J Public Health*. 2011;39(7 Suppl):30–33. doi:10.1177/1403494811401482
- Helweg-Larsen K. The Danish register of causes of death. *Scand J Public Health*. 2011;39(7 Suppl):26–29. doi:10.1177/1403494811399958
- Munk-Jørgensen P, et al. The Danish Psychiatric Central Register. *Dan Med Bull*. 1997;44(1):82–84.
- Udholm S, et al. Congenital heart disease and risk of suicide and self-harm: a Danish Nationwide Cohort Study. *J Am Heart Assoc*. 2020;9(10):e015735.
- Latouche A, et al. A competing risks analysis should report results on all cause-specific hazards and cumulative incidence functions. *J Clin Epidemiol*. 2013;66(6):648–653.
- Fine JP, et al. A proportional hazards model for the subdistribution of a competing risk. *J Am Stat Assoc*. 1994;446:496–509. doi:10.1080/01621459.1999.10474144
- Schröder CM, et al. Depression and Obstructive Sleep Apnea (OSA). 2005;4:13. doi:10.1186/1744-859X-4-13
- Jean-Louis G, et al. Obstructive sleep apnea and cardiovascular disease: role of the metabolic syndrome and its components. *J Clin Sleep Med*. 2008;4(3):261–272.
- Wu VCC, et al. Suicide death rates in patients with cardiovascular diseases – a 15-year nationwide cohort study in Taiwan. *J Affect Disord*. 2018;238:187–193. doi:10.1016/j.jad.2018.05.046
- Krakow B, et al. Sleep disorder, depression, and suicidality in female sexual assault survivors. *Crisis*. 2000;21(4):163–170.
- Bishop TM, et al. The association between sleep apnea and suicidal thought and behavior: an analysis of national survey data. *Focus Suicide J Clin Psychiatry*. 79(1):17m11480. doi:10.4088/JCP.17m11480
- Bishop TM, et al. Sleep, suicide behaviors, and the protective role of sleep medicine. *Sleep Med*. 2020;66:264–270.
- Olaïthe M, et al. Executive dysfunction in OSA before and after treatment: a meta-analysis. *Sleep*. 2013;36(9):1297–1305. doi:10.5665/sleep.2950
- Executive function and suicidality: a systematic qualitative review. Elsevier Enhanced Reader. <https://reader.elsevier.com/reader/sd/pii/S0272735815000951?token=3A65A40519FD74D7D1F7B8DACCD76F34756F56DCC9D5533357C34A4710BD5D015CCD0258985EC2406D479882B392935F&originRegion=eu-west-1&originCreation=20210710202911>. Accessed July 10, 2021.
- Gujral S, et al. Impaired executive function in contemplated and attempted suicide in late life. *Am J Geriatr Psychiatry*. 2014;22(8):811–819.
- Nordentoft M, et al. Registration, psychiatric evaluation and adherence to psychiatric treatment after suicide attempt. *Nord J Psychiatry*. 2005;59(3):213–216.
- Basto-Abreu A, et al. The relationship of socioeconomic status with body mass index depends on the socioeconomic measure used. *Obesity (Silver Spring)*. 2018;26(1):176–184.
- Merritt T, et al. Tobacco smoking and its consequences on reproductive health: the impact of a lifestyle choices including cigarette smoke exposure on fertility and birth defects. *Przegl Lek*. 2013;70(10):779–783.