**Best practice in reducing suicide risk in head and neck cancer patients: a structured review**

**Twigg JA[1], Anderson JM[2], Humphris G[3], Nixon I[4], Rogers SN[5], Kanatas A[6]**

1. Joshua Twigg, BDS(hons), PhD, Dental Core Trainee / Academic Clinical Fellow, Leeds Teaching Hospitals Trust and Leeds Dental Institute denjtw@leeds.ac.uk
2. Jane Anderson, BSc(hons) Trainee Advanced Care Practitioner/Registered Mental Health Nurse, Leeds Teaching Hospitals Trust
   jane.anderson15@nhs.net
3. Professor Gerald Humphris, PhD, MClinPsychol, PostgradDipSocEcon, University of St. Andrews.
   gmh4@st-andrews.ac.uk
4. Dr Ioanna Nixon, MPH, PhD, FFMLM Consultant Clinical Oncologist The Beatson West of Scotland Cancer Centre and Visiting Professor, Strathclyde University, Glasgow
   Ioanna.Nixon@strath.ac.uk
5. Professor Simon N Rogers, BDS, MBChB(hons), FDSRCS(Eng), FRCS(Eng), FRCS(max), MD, Consultant Surgeon / Professor, University Hospital Aintree and University of Liverpool.
   simonn.rogers@aintree.nhs.uk
6. Professor Anastasios Kanatas, MFDSRCS, FRCS (OMFS), MD, PGC, FHEA. Consultant Surgeon / Professor, Leeds Teaching Hospitals and St James Institute of Oncology and Leeds Dental Institute.
   a.kanatas@doctors.org.uk

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**Abstract**

Treatment of head and neck cancer (HNC) is often radical and the patient journey can be challenging, especially for individuals struggling with pre-existing mental health problems and lacking social support. Patients frequently suffer from high levels of emotional distress at some point prior to, during, or after treatment and their risk of suicide is markedly elevated. This structured review aimed to identify the extend of the problem, appropriate interventions and areas of future research. We found that the incidence of suicide among HNC patients was significantly elevated above that of the demographically matched general population. Furthermore, suicide risk in HNC patients was frequently higher, than for all other cancer sites. Despite the clear burden of suicide in HNC patients, there is an absence of evidence evaluating interventions to reduce suicidal ideation and suicide risk. Recommendations for practice are made, drawing from the wider literature on suicide prevention.

**Background**

Head and neck cancers (HNCs) are the 7$^{th}$ most common form of cancer globally[1]. In England, there were approximately 7601 cases of HNC diagnosed in 2011[2]. Worryingly, this same report suggested that the incidence of HNC is rising, predicting a further rise in incidence of greater than 50% by 2025. Recent years have seen a change in the demographic of HNC patients due to a number of factors, including a rise in HPV-positive HNCs which tend to affect younger individuals and have a more favourable prognosis[3]. In keeping with these emerging trends in HNC aetiopathogenesis, there has been a concomitant increase in overall survival[4]. Consequently, renewed focus on enhanced quality of life in such patients is warranted.

Suicide is a potentially preventable cause of mortality in HNC patients[5]. Risk of suicide is markedly elevated among HNC patients compared to many other cancer types or demographically matched controls[6]. This increased risk may relate to the associated morbidity

that results from HNC and its treatment, including loss of masticatory function, impaired speech, disfigurement and associated dysphoria[7]. It has also been suggested that increases in suicide seen among cancer patients may reflect pre-cancer mental health problems[8]. Depression, anxiety and a number of psychological problems correlate strongly with lifestyle factors which increase HNC risk; most notably alcohol and tobacco use[9]. Despite widespread recognition that suicidal ideation and suicide is a significant problem in HNC survivors, there is a dearth of research evaluating interventions to identify, prevent or manage suicide risk in practice. It should be noted that while suicidal ideation (which ranges from "thinking about, considering or planning suicide") is a risk factor for suicide, only a small proportion of those individuals expressing suicidal ideation will go on to commit suicide[10]. This review therefore seeks to:

- explore the available literature to determine the prevalence and attributable mortality of suicide in HNC survivors
- evaluate current practice aimed at identification of suicide or interventions to reduce suicide and suicidal ideation among such patients
- identify areas of further research need

**Methods**

The literature was searched systematically using the following databases: MEDLINE via Ovid, CINAHL, Embase, PsycINFO and the Cochrane Central Register of Controlled Trials (CENTRAL), using a combination of MESH subject headings and key terms (supplemental information) relating to suicide or suicidal ideation in head and neck cancer patients. Studies which reported suicide or suicidal ideation in head and neck cancer patients (at any stage of diagnosis or treatment) were included. No restrictions were imposed on the date of publication, study design or number of participants. Only original studies published in English were included. Where the primary outcome of a study did not relate to HNC specifically, the study

was included if it reported data for a cohort of HNC patients as a subgroup. Further hand-searching of previously published reviews on the subject and in the reference lists of included studies was undertaken.

**Results and Discussion**

The literature search identified 364 records after removal of duplicates. These records were screened independently by two authors (JA, JT). When there were disagreements regarding whether a paper should be included or excluded papers, two senior authors (AK,SNR) adjudicated to achieve consensus. Two further studies were identified through hand-searching of reference lists. Following screening, 37 full text records were obtained for further assessment, with 281 records excluded due to lack of relevance. After assessment, 18 articles were excluded with reasons provided (Table 1) and 19 included for further analysis. Figure 1 summarises the study selection process.

The majority of included studies were conducted in - or examined participants from - the USA (n=13). Of the remaining 6 studies, one study was conducted in Norway, Austria, Taiwan, England, Estonia and Canada, respectively. Fourteen of the included studies were secondary analyses of epidemiological databases and cancer registries. One study[11] reported a retrospective chart review of a single OMFS oncology centre. One study[12] employed a prospective longitudinal design, following 223 newly diagnosed HNC patients over 1 year in two head and neck surgery outpatient departments. Only one interventional study was included[13]. This randomised control trial evaluated the effect of citalopram to prevent major depressive disorder in the first 16 weeks after therapy for HNC. Although neither suicide nor suicidal ideation were specified outcome measures for this trial, both suicidal ideation and attempted suicide were reported as part of the Mini International Neuropsychiatric Interview (MINI) assessment tool used in this study. Of the remaining 16 studies included, 15 used completed suicide as the primary outcome, while in 1 study suicidal ideation was the primary

outcome. A summary of the characteristics and relevant findings of included studies is provided in Table 2. Observational studies consistently found that suicide risk was increased patients with any type of cancer compared with aged, sex and race-matched general population controls. This was frequently expressed as the standardized mortality ratio (SMR), ranging from 1.2[14] to 4.44[15]. In several studies comparing suicide rate by cancer site, HNC carried the highest suicide risks, with all studies reporting HNC as having an elevated suicide risk beyond all-site cancers. Estimates of SMR varied substantially between studies, ranging from 1.67[14] to 37.1[16]. It should be noted that the high SMR reported by Massa et al.[16] is considerably higher than has otherwise been reported. This may be related to limited analysis of SCCs within the study. Additionally, while cancer patient data was only recorded for the period of 2004-11, the general population mortality rate was generated from data spanning 1969-2014, despite considerable change in suicide trends over this time. Other studies within the same US cancer registry have found SMRs for suicide to range from 3.66[17] to 6.08[15]. Most studies reported ethnicity (white), gender (male) and marital status (single, widowed or divorced) to carry an increased risk of suicide within the cohorts evaluated. In all such studies that explored the impact of time since diagnosis, the risk of suicide was highest in the first few months following HNC diagnosis and reduced substantially after 1 year. The discrepancy observed between mortality estimates from Henson et al.[14] and the majority of similar population-level studies may reflect a number of factors. Most of the studies evaluated patient data from the US Surveillance, Epidemiology and End Results Program (SEER) registry. An important difference between the US and UK include access to firearms, which is the most common mode of suicide in the US [18] compared with hanging in the UK[19]. The US population also has a higher rate of depression, anxiety and substance abuse compared with the UK[20], all of which may contribute to increased incidence of suicide. Critically, there are systematic disparities in the classification of death by suicide in each country. In the UK, the standard of proof for death by

suicide was aligned with that of criminal justice, i.e. 'beyond reasonable doubt'. This precedent was recently overturned in favour of a 'balance of probability'[21], but this occurred after the period analysed by Henson et al.[14]. In the US, the standard of proof required differs across states and depends in part on whether the assignment of cause of death is undertaken by a medical examiner or coroner[22]. It remains unclear to what extent such factors may contribute to the differences observed between such studies.

A retrospective case note review by[11] identified 3 patients who had completed suicide, 2 patients who were documented as experiencing suicidal ideation, and 4 patients who refused further treatment or counselling, out of a total of 241 HNC patients seen over 5 years at a single US OMFS oncology centre. It is important to note that screening for suicidal ideation was not common practice during the time evaluated, so was likely underestimated. The authors identified hopelessness as a significant factor that may have triggered the 3 suicides, each of which could only be elucidated by an in-depth evaluation of the patients personal and social circumstances, preferences and values. Of note, all 3 patients who completed suicide were married with children and were reported to have strong social support in place. The small sample size evaluated limits the strength of any inferences that can be made from this observation but highlights the importance of individual context that is frequently lost in population-level assessments.

Henry et al.[12] conducted a prospective longitudinal study, consecutively recruiting 223 patients within the first 2 weeks of HNC diagnosis for 1 year. Participants completed a number of psychological tests, including the Beck Scale for Suicidal Ideation. They found a 1-year prevalence for suicidal ideation of 15.7% (n=35). Of these 35 suicidal patients, 71.4% (n=25) were assessed as at low risk for suicide, 20% (n= 7) at medium risk and 8.6% (n= 3) at high risk of suicide. During the study period, 2 patients attempted suicide and 1 (additional) patient completed suicide. The suicide risk assessment category was not reported in these patients.

Predictors of suicidality were self-reported psychiatric history and substance use as a mechanism of coping with HNC diagnosis. Further exploratory covariates identified as correlating with suicidality were reduced quality of life, increased HNC-related symptom burden (pain, speech impairment) and psychological distress (assessed by the Hospital Anxiety and Depression Scale). Importantly, the rate of suicidal ideation was approximately 4 times that seen in the general population, mirroring the disparity in rates of completed suicide observed in large-scale epidemiological studies.

In the only intervention trial identified (n=36), Lydiatt et al.[13] suggested that a 12-week dose of 20-40 mg citalopram was effective in preventing major depressive disorder (MDD) in the first 16 weeks following cancer therapy, although the effect was not statistically significant with the exception of an improved global mood state score (measured by Clinician Global Impression-Severity scale). While not a prespecified outcome, the investigators captured data on suicidal ideation as part of their psychological assessment tool. They identified 2 patients expressing suicidal ideation in the control group, while no patients displayed suicidal thoughts in the intervention group. No patients were reported to have attempted or completed suicide during the study period. Importantly, this study was underpowered for the primary outcome, and certainly had not been powered to detect differences in suicidal ideation. However, it is reasonable to assume that effective prevention of MDD might lead to reduced suicidality in the HNC population, as this mechanism has been demonstrated for this intervention elsewhere[23].

With the exception of Lydiatt[13], there is no available evidence evaluating interventions to reduce suicidal ideation or suicide in HNC populations, despite a substantial body of evidence demonstrating that such patients are at an increased risk of suicidality. A diagnosis of cancer is a highly psychologically distressing event[24], which can lead to substantial anxiety, depression and risk of suicide[25]. Patients diagnosed with HNC in particular may carry additional psychosocial burdens of loss of normal speech, masticatory function and enjoyment

and disfigurement. These can directly impact on quality of life and lead to social isolation[26], which may both further increase the risk of psychiatric symptoms and suicide among such individuals. Furthermore, the incidence pre-existing psychiatric illness, substance abuse and suicidality are all elevated in HNC populations[27], marking this group as higher risk than the general population regardless of cancer diagnosis. Suicide is a complex phenomenon, that represents the outcome of interactions between a multitude of psychosocial, behavioural and physiological factors[28]. The majority of suicide prevention strategies in the UK have focused on young and middle-aged men, people in the care of mental health services, people in contact with the criminal justice system, people with a history of self-harm and specific occupational groups such as medical staff and agricultural workers[29]. The profile of HNC patients may not fall under the remit of such strategies, as patients are typically older, may not have experienced contact with mental health services (regardless of mental illness), nor have a known history of self-harm. It should be noted that while self-harm does not necessarily correlate with suicidality, self-harm in individuals over the age of 60 is much more likely to be 'high intent' and thus may be a more reliable indicator of suicide risk[30]. Where interventions have been targeted specifically at elderly populations, these have primarily focused on primary care or community outreach models of delivery. Such programmes typically include multilevel interventions; education about treatment options, workshops and peer support groups, interpersonal or behavioural psychotherapy and psychiatric medication with stringent monitoring[31]. These interventions necessitate frequent follow-up (often fortnightly or monthly), which would be prohibitively time-intensive for secondary care providers, emphasizing the need for integration of secondary care with primary care and outreach facilities. Of note, one meta-analysis of Japanese data[32] demonstrated a lack of effectiveness of an intervention delivered by GMPs, while the same intervention was found to be effective when delivered by a clinical psychiatrist, highlighting the reliance upon suitably trained staff

in psychosocial therapy. A short, intensive clinical intervention of nortriptyline hydrochloride combined with interpersonal psychotherapy showed promise in reducing suicidality, which was maintained with low relapse rates (up to 26%) over a subsequent period of 3 years of bimonthly maintenance treatment[33]. Where sex differences in response to interventions are explored, female patients are often found to respond more favourably, with little or no impact in male patients[31]. This has obvious ramifications to HNC patients, where the majority of the burden of suicide is found in male patients. However, no studies have directly studied suicide prevention in HNC cancer patients, despite the important demographic differences in such individuals. Similarly, there is a dearth of literature exploring the relationship between suicide-related behaviours, such as deliberate self-harm, non-compliance with treatment and self-neglect and suicidal ideation or attempted/completed suicide. A number of studies have evaluated interventions aimed at improving mood and/or quality of life in HNC patients, reviewed in depth in Senchak et al.[34]. While these studies may offer insights into the modality of interventions best suited to improve wellbeing and therefore decrease suicide risk in such patients, the overall quality of such evidence is poor, with low sample sizes, divergent outcome measures and short follow-up periods. No studies included suicidal ideation or suicide attempts/completion as explicit outcome measures, and all would certainly be underpowered to detect differences in these events. This knowledge gap represents an important shortfall in understanding and managing the complex interplay of events, cognitive and psychosocial processes that lead to suicide. As the event rate of completed suicides in HNC patients is relatively low, suicide may be perceived as a disproportionately low risk in individual units without formal and proactive screening to assess suicidal ideation and intent. Accurate assessment of treatment need, based on targeted suicide risk assessment combined with background factors such as history of psychiatric symptoms or care, sociodemographic factors

and contextual factors at an individual level may allow stratification of suicide risk and tailoring of treatment to the needs of each patient.

**Summary of findings**

Based on the evidence available, we found that:

- There is a significant increase in suicides in individuals with HNC that exceeds most other cancer types, ranging from an approximately 20% to 600% increase.
- The most at-risk patient profile is male, Caucasian and not married, with a history of psychiatric illness and substance abuse.
- Suicidal ideation among HNC patients appears to be significant, and largely unexplored. The degree to which such thoughts translate to attempted or completed suicide remains unknown.
- There is a dearth of research evaluating interventions to reduce suicidal ideation or suicide risk in HNC patients. This is a significant, unmet need for this population.

**Recommendations for practice**

- Assessment of mental state, including suicide risk assessment, should constitute an integral part of the management of HNC patients, from the time of diagnosis to at least 1 year following completion of therapy. Recurrent or new malignancies after primary therapy should ‘reset the clock’ on this screening process.
- Effective suicide prevention requires multilevel interventions, with a significant component delivered through primary care or community outreach and requires expert input from clinical psychiatry and psychology.
- A combination of pharmacological and psychosocial intervention, focusing on building peer support and resilience appears to be most effective for suicide prevention based on current limited evidence.

- Further research exploring suicidal ideation and suicide in HNC patients and evaluating interventions to reduce suicidal thoughts and suicide risk is urgently needed to address this preventable competing cause of mortality.

**Conflict of interest:** The authors have no conflict of interest to report

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## Table 1: Studies included in this review

| Author(s) | Study design | Participants & Setting | Outcomes & Effect size (SMR for suicide vs. reference population; 95% CI unless otherwise specified) | Comments |
|---|---|---|---|---|
| Innos et al.[35] | Retrospective Cohort | 65,419 patients with any cancer vs. Estonian general population.<br>Diagnosed 1983 – 2000.<br>Secondary analysis of Estonian Cancer Registry. | Overall:<br>Male 1.73 (1.45-2.01)<br>Female 0.5 (0.37 - 0.6)<br>Lip, oral cavity & pharynx<br>Days post diagnosis:<br>0-89<br>Males 0.00 (0.00-7.94)<br>Females 0.00 (0.00-51.16)<br>90-179<br>Males 7.41 (1.53-21.64)<br>Females 15.18 (0.38-4.59)<br>180- 364<br>Males 6.2 (1.69-15.88)<br>Females 0.00 (0.00– 31.31) | Low number of suicides overall (197 total). Number of HNC patients not specified. |
| Hem, Loge [36] | Retrospective Cohort | 490245 patients with any cancer vs. Norwegian general population.<br>Diagnosed 1960 – 1997.<br>Secondary analysis of Cancer Registry of Norway. | All cancers:<br>589 suicides (0.0012%)<br>SMR 1.48 (1.37-1.61)<br>Buccal cavity & pharynx<br>27 suicides<br>SMRs:<br>Male1.55 (0.96-2.32)<br>Female 3.67 (1.35-7.99) | Low numbers of suicides within HNC cohort.<br>HNC cohort size not specified. |
| Kendal [37] | Retrospective Cohort | 1.3m patients with any cancer vs. USA general population.<br>Diagnosed 1973 -2001.<br>Secondary analysis of SEER database USA. | All cancers:<br>Suicide HR[1] by gender<br>Males 6.2 (5.4-7.1)<br>HNC (n=80747):<br>Suicide HR[1] by gender<br>Males 4.7 (2.98-7.3)<br>Males – 99 suicides (0.32%) Females – 7 suicides (0.05%)<br>Factors associated with increased HR for suicide:<br>Surgery – contraindicated or refused<br>Site – pharyngeal involvement<br>Stage/grade - advanced and less differentiated<br>Marital status - single, widowed or divorced<br>Race – white | HNC has highest HR for suicide of all cancer sites, the highest risk of suicide for males and the 4th highest for females.<br>Large, well-defined HNC cohort. |
| Misono, Weiss [17] | Retrospective Cohort | 3.5m patients with any cancer vs.<br>USA general population. | All cancers:<br>1.88 (1.83-1.93)<br>Oral cavity/pharynx (n=51807) | Large HNC cohort.<br>Up to 30 y follow-up data. |

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| | | Diagnosed 1973 – 2002.<br>Secondary analysis of SEER databaseUSA. | SMR 3.66 (3.16-4.22)<br>Male – 3.71 (3.18-4.31)<br>Female – 3.23 (1.96-5.03)<br>Time since diagnosis<br>0-5 y 4.65 (3.92-5.48)<br>5-10 y 2.23 (1.47-3.23)<br>10-15 y 1.81 (0.87-3.29)<br>15-30 y 3.38 (1.75-5.85) | |
| Schneider and Shenassa [38] | Retrospective Cohort | 980 patients with any cancer vs. USA general population.<br>Died in 1993.<br>Secondary analysis of 6th National Mortality Followback Survey USA. | Suicidal ideation as reported by family in the last year of life<br>All cancers:<br>17.7% (n=156)<br>Lung/respiratory/oral cancers:<br>AOR[2] 5.74 (3.04-9.98)<br>Rate of reported suicidal ideation – 30% (n=63, estimated from available data). | HNC has the highest AOR for suicidal ideation of all cancer sites.<br>Small sample size and indirect method of ascertaining suicidal ideation.<br>HNC grouped with respiratory/lung cancers – limited specificity. |
| Yu, Mehta [39] | Retrospective Cohort | 32487 HNC patients vs. USA general population.<br>Diagnosed 1980-2007.<br>Secondary analysis of SEER database USA.<br>. | Suicide prevalence by time period observed:<br>1980-84 – 0.4% (n=3)<br>1990-94 – 0.6% (n=5)<br>2000-03 – 1.3% (n=8)<br>2004-07 – 1.8% (n=10)<br>Year of diagnosis (data for 2000-2007 cohorts only)<br>1 - 7.8 (4.6-12.4)<br>2 - 3.7 (1.8-6.6)<br>3 - 2.5 (0.5-7.3)<br>Factors associated with increased suicide risk:<br>Treatment - no treatment, radiation or surgery alone<br>Site - Pharynx, oral cavity<br>Stage – distant spread/unstaged<br>Sex - Male (100% of suicides)<br>Age - elevated for patients age >45 y, peaks in 55-64 y age group<br>Marital status - single, divorced or widowed<br>Race - white | Low number of suicides (n=32).<br>Suicide in HNC cohort is a primary outcome. |

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| Oberaigner, Sperner-Unterweger [40] | Retrospective Cohort | 53803 patients with any cancer vs. Austrian general population.<br>Diagnosed 1991 – 2010.<br>Secondary analysis of Cancer Incidence in Five Continents Database for cases diagnosed in Tyrol. | All cancers:<br>1.86 (1.57-2.19)<br>HNC:<br>4.73 (2.52-8.09)<br>Male (n=12) - 4.92 (2.54-8.60)<br>Female (n=1) – 3.22 (0.08-17.95) | HNC has the highest risk for suicide of all cancer sites.<br>HNC cohort size not specified.<br>Low number of suicides in HNC cohort (n=13). |
| Kam, Salib [41] | Retrospective Cohort | 350413 HNC patients vs. USA general population.<br>Diagnosed 1973 – 2011.<br>Secondary analysis of SEER database USA.<br>. | 3.21 (2.18-4.23)<br>Male (n=757) – 3.67 (2.80-4.53)<br>Female (n=100) 1.62 (0.53-2.71)<br>857 suicides (prevalence of 2.45 per 100000)<br>Factors associated with increased suicide risk:<br>Site – hypopharynx > larynx > oral cavity/oropharynx > nasopharynx<br>Stage – regional/distant spread<br>Treatment – radiation only/no treatment<br>Race – white<br>Marital status – Unmarried<br>Time since diagnosis –5 y | Marked elevation in suicide risk in first 5 y since diagnosis (3-5x risk vs. 5-10 y).<br>Large, well-defined cohort of HNC patients with up to 30 y follow-up data.<br>Suicide in HNC cohort primary outcome. |
| Massa, Osazuwa-Peters [5] | Retrospective Cohort | 64598 HNC patients (SCC) vs. USA general population<br>Diagnosed 2004-11.<br>Secondary analysis of SEER database USA. | 37.1 (26.1-48.6)<br>(n=1163; prevalence 1.8%) | Sample limited to patients with SCC.<br>Discrepancy between HNSCC population diagnosis/mortality times and general population times – may skew results. |
| Osazuwa-Peters, Arnold [42] | Retrospective Cohort | 287901 HNC patients vs. USA general population.<br>Diagnosed 1973 – 2014.<br>Secondary analysis of SEER database USA. | 1036 suicides (prevalence 3.6 per 100000).<br>Factors associated with increased aRR[3] for suicide:<br>Site – hypopharynx > nasopharynx > oropharynx > larynx<br>Stage – regional<br>Treatment – none<br>No. of primary tumours – single primary<br>Sex – male<br>Age - ≥70 > 60-69 > 40-59<br>Race – white<br>Marital status – widowed | No influence of HPV relatedness on suicidality.<br>Large, well-defined cohort |
| Osazuwa-Peters, Simpson [43] | Retrospective Cohort | 4.2 million patients with any cancer vs. USA general population. | All cancers:<br>4493 suicides ( prevalence 1.1 per 100000) | Most suicides (all cancers) in males >50 years of age |

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| | | Diagnosed 2000 – 2014.<br>Secondary analysis of SEER database USA. | Suicide (HNC) n=404 (2.7 per 100000)<br>HNC aRR[3] 1.97 (1.77-2.19) vs. other cancer patients | Large, well-defined HNC cohort directly compared with other cancer sites.<br>Suicide rates increasing from 2000-04 to 2010-14. |
| Wang, Chang [44] | Retrospective Case-Crossover | 2907 patients with any cancer vs. 52523 Taiwan general population, who had committed suicide between 2000-07.<br>Secondary analysis of the National Health Insurance Research Database Taiwan. | Suicide (all cancers) n=2907 (0.68% of all deaths)<br>Lip, oral cavity & pharynx n=445 (1.34% of all deaths) | HNC has the highest risk for suicide of all cancer sites.<br>Unusual study design with self-controlled samples using pre-diagnosis data as reference. |
| Henson, Brock [14] | Retrospective Cohort | 4,722,099 patients with any cancer vs. English general population.<br>Diagnosed 1995 – 2015.<br>Secondary analysis of National Cancer Registration and Analysis Service England. | All cancers:<br>2491 suicides (prevalence 0.05%)<br>SMR 1.2 (1.16-1.25)<br>HNC n=176 (prevalence 0.1%)<br>SMR 1.67 (1.44-1.94) | Large, well defined cohort.<br>Only study conducted in UK.<br>NB – substantial change in classification of suicide as cause of death since data collection (see discussion). |
| Klaassen, Wallis [8] | Retrospective Cohort | 676,470 patients with any cancer vs. USA general population (n=2,152,682)<br>Diagnosed 1997 – 2014.<br>Secondary analysis of SEER database USA. | All cancers:<br>HR[4] = 1.34 (1.22-1.48)<br>Oral cancer:<br>HR 2.55 (1.59-4.12) | HNC has the highest risk for suicide of all cancer sites.<br>Suicide rates increasing from 1997-2002 to 2009-14. |
| Thavarajah et al.[45] | Retrospective Cohort | 218,048 HNC patients.<br>Diagnosed 1973 – 2014.<br>Secondary analysis of SEER database USA. | 774 suicides (prevalence 0.35%)<br>Factors associated with increased suicide risk:<br>Sex - male (91.7% of suicides)<br>Race - caucasian (93% of suicides)<br>Time since diagnosis - <6 months | Large HNC population.<br>SMRs or equivalent statistics to quantify suicide risk not reported for specific clinical/demographic factors. |
| Zaorsky, Zhang [6] | Retrospective Cohort | 8,651,569 patients with any cancer vs. USA general population. | All cancers:<br>13311 suicides (prevalence 0.15%)<br>SMR 4.44 (4.33-4.55) | HNC cohort size not specified. |

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| | | Diagnosed 1973 – 2014.<br>Secondary analysis of SEER database USA. | HNCs:<br>81 suicides<br>SMR 6.08 (5.44-6.76)<br><1 y after diagnosis 12.57 (9.99-15.28)<br>1-5 y after diagnosis 6.99 (5.87-8.25)<br>>5 y after diagnosis 4.01 (3.31-4.81)<br>Male n=74<br>SMR 5.97 (5.32-6.68)<br>Female n=7<br>SMR 7.45 (4.95-10.77) | Low number of suicides in HNC cohorts. |
| Henderson and Ord [11] | Chart Review | 241 HNC patients.<br>Attending University of Maryland OMFS oncology service 1991 – 1996 USA. | Primary outcome - Suicide, suicidal ideation or therapy refusal.<br>3 suicides (1.2%)<br>2 patients with suicidal ideation (0.8%)<br>4 refused treatment or counselling (1.7%) | All patients who committed suicide were males over 40 years of age, married with children and had social support. |
| Henry, Rosberger [46] | Prospective Longitudinal | 223 consecutive HNC patients seen within 2 weeks of diagnosis at 2 head and neck surgery outpatient departments in Canada. | 35 (15.7%) HNC patients suicidal <1 year from diagnosis.<br>Suicidal ideation rates over time:<br>• 18 (8.1%) <2 weeks<br>• 33 (14.8%) 3 months<br>• 21 (9.4%) 6 months<br>• 23 (10.4%) 12 months | Beck Scale for Suicidal Ideation and Structured Clinical Interview for DSM-IV-TR Axis I Disorders used to assess suicidal ideation. |
| Lydiatt, Denman [47] | Double-blinded Randomised Control Trial | 36 HNC patients.<br>Randomised in academic outpatient setting USA, July 2002-April 2005. | Citalopram reduced MDD diagnosis by 19% (-59-21).<br>2 patients expressing suicidal ideation in control group vs. 0 in intervention group. | Intervention – 12 week course of 20-40 mg citalopram. Sixteen-week follow-up only.<br>Study powered for 80 patients but stopped early due to logistical problems. |

## Table 2: Excluded studies

| Author(s) | Study Design | Reason for exclusion |
|---|---|---|
| Aboumrad, Shiner [48] | Root cause analyses | No HNC data reported |
| Hernandez Blazquez and Cruzado [49] | Longitudinal | No specific HNC outcomes reported |
| Mallet, Huillard [50] | Cross sectional | No specific HNC outcomes reported |
| Sengul, Kaya [51] | Cross sectional | No specific HNC outcomes reported |
| Walker, Waters [52] | Cross sectional | HNC cohort not included |
| Anguiano, Mayer [53] | Review | No primary data |
| Ferlito, Haigentz [54] | Review | No primary data |
| Friedland [55] | Review | No primary data |
| Friedlander, Rosenbluth [56] | Review | No primary data |
| Haisfield-Wolfe et al.[57] | Review | No primary data |
| Harris and Barraclough [58] | Review | No primary data |
| Lydiatt, Moran [59] | Review | No primary data |
| Purushotham, Bains [60] | Review | No primary data |
| Shuman, Duffy [61] | Review | No primary data |
| Smith, Shuman [62] | Review | No primary data |
| Mahalingam and Spielmann [63] | Review | No primary data |
| Williams [64] | Review | No Primary data |
| Panwar, Rieke [65] | Secondary analysis of RCT | Suicide/suicidal ideation not reported as an outcome |

**Figure 1: PRISMA Diagram[66]**