

with attempted suicide are more likely to be treated either in accident and emergency departments or on general medical wards before transfer to OAP units. Finally, a causal relationship between elderly suicide rates and provision of mental health services and its direction cannot be inferred from this cross-sectional ecological study.

### Conflict of interest

None.

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### The relationship between elderly suicide rates and smoking in England and Wales

Completed suicides have been shown to be associated with smoking cigarettes in cohort studies

of mainly female registered nurses in the U.S.A. (Hemenway *et al.*, 1993), both sexes in the Finnish general population (Tanskanen *et al.*, 2000), male army recruits in the U.S.A. (Miller *et al.*, 2000a), males in the U.S. general population (Davey Smith *et al.*, 1992), army recruits in Sweden (Hemmingsson and Kriebel, 2003), males

**Table 1.** Correlations between elderly suicide rates and prevalence of smoking

PREVALENCE OF SMOKING	SUICIDE RATES			
	MALES 65–74 YEARS	MALES 75+ YEARS	FEMALES 65–74 YEARS	FEMALES 75+ YEARS
General population both sexes combined	$\rho = +0.92$ P < 0.0001	$\rho = +0.62$ P = 0.028	$\rho = +0.95$ P < 0.0001	$\rho = +0.91$ P < 0.0001
General population males	$\rho = +0.94$ P < 0.0001	$\rho = +0.76$ P = 0.004	$\rho = +0.93$ P < 0.0001	$\rho = +0.88$ P < 0.0001
General population females	$\rho = +0.89$ P < 0.0001	$\rho = +0.77$ P = 0.004	$\rho = +0.94$ P < 0.0001	$\rho = +0.93$ P < 0.0001
Those aged 60+ years, both sexes combined	$\rho = +0.97$ P < 0.0001	$\rho = +0.74$ $\rho = 0.014$	$\rho = +0.94$ P < 0.0001	$\rho = +0.93$ P < 0.0001
Those aged 60+ years, males	$\rho = +0.95$ P < 0.0001	$\rho = +0.85$ P < 0.0001	$\rho = +0.92$ P < 0.0001	$\rho = +0.96$ P < 0.0001
Those aged 60+ years, females	$\rho = +0.89$ P < 0.0001	$\rho = +0.80$ P < 0.0001	$\rho = +0.91$ P < 0.0001	$\rho = +0.91$ P < 0.0001

aged 40–69 years in the general population in Japan (Iwasaki *et al.*, 2005), and the elderly in a retirement community in the U.S.A. (Ross *et al.*, 1990). Also, a Swiss case-control study of army recruits reported similar findings (Angst and Clayton, 1998). Additionally, positive correlation between prevalence rates of smoking and both general population (Shah and Bhandarkar, 2008) and elderly (Shah, 2008) male suicide rates has been observed in large cross-national ecological studies. This relationship between completed suicides and smoking was “dose-dependent” (Hemenway *et al.*, 1993; Tanskanen *et al.*, 2000; Miller *et al.*, 2000a; Davey Smith *et al.*, 1992; Hemmingsson and Kriebel, 2003; Iwasaki *et al.*, 2005). Moreover, this relationship was maintained in some studies after controlling for confounding variables including demographic characteristics, socioeconomic characteristics, levels of alcohol consumption, psychiatric symptoms and physical health (Tanskanen *et al.*, 2000; Miller *et al.*, 2000a), but disappeared in other studies (Hemmingsson and Kriebel, 2003; Shah, 2008; Shah and Bhandarkar, 2008).

The relationship between smoking and completed suicides has mainly been examined in cohort or case-control studies at an individual-level in younger subjects, and there is a paucity of studies examining this relationship in the elderly. Therefore, the relationship between elderly suicide rates and the prevalence of smoking in England and Wales was examined.

Data on elderly suicide rates for males and females in the age-bands 65–74 years and 75+ years for England and Wales were ascertained from the World Health Organization website ([http://www.](http://www.who.int/whosis/database/mort/table1.cfm)

[who.int/whosis/database/mort/table1.cfm](http://www.who.int/whosis/database/mort/table1.cfm)) for the 23-year period 1979 to 2001.

Data on the prevalence of smoking in England for the general population and those over the age of 60 years in males and females were ascertained from the Office of National Statistics for every alternate year between 1978 and 2000 and for the year 2001. These data on the prevalence of smoking were derived from serial General Household Surveys in England between 1978 and 2002.

The relationship between suicide rates in both elderly age-bands in both sexes and the prevalence of smoking in the general population and in those over the age of 60 years in the general population for males, females and both sexes combined was examined using Spearman’s correlation coefficient ( $\rho$ ).

Data on elderly suicide rates and the prevalence of smoking were available for 10 separate years (nine of the alternate years between 1978 and 2000 and for the year 2001). Table 1 illustrates that there were significant positive correlations between suicide rates in both elderly age-bands in both sexes and the prevalence of smoking in the general population and in those over the age of 60 years in the general population for males, females and both sexes combined. There may be several possible explanations for these findings including methodological issues. Data on suicide rates were for England and Wales, whereas data on the prevalence of smoking were for only England. However, it is unlikely that the suicide rates for England and Wales were significantly influenced by the suicide rates for Wales as the population size of Wales is significantly smaller than that of England. The positive correlations may have

been spurious due to type 2 statistical errors because there were only a small number of data points ( $N = 10$ ). Other confounding variables may independently influence the trends over time in both elderly suicide rates and the prevalence of smoking, leading to a spurious correlation between these two variables (epiphenomena). However, as noted above, this relationship was maintained in some previous studies after controlling for confounding variables including demographic characteristics, socioeconomic characteristics, levels of alcohol consumption, psychiatric symptoms and physical health (Tanskanen *et al.*, 2000; Miller *et al.*, 2000a). Such confounding variables were not examined in this study.

The positive correlations between suicide rates in both elderly age-bands in both sexes and the prevalence of smoking in the general population and in those over the age of 60 years in the general population for males, females and both sexes combined were consistent with the previously observed relationship between smoking and completed suicides in cohort and case-control studies at an individual-level in younger subjects, a cohort study of the elderly in a retirement community in the U.S.A. (Ross *et al.*, 1990), and general population (Shah and Bhandarkar, 2008) and elderly (Shah, 2008) male suicide rates in large cross-national ecological studies. Thus, the findings of the current study may be genuine.

There has been much debate about the possible causal link between smoking and completed suicides (Davey Smith *et al.*, 1992; Sheikh, 2000; Miller *et al.*, 2000b). A number of potential explanations have been proposed. First, there may be a causal link between smoking and depressive illness (Hemenway *et al.*, 1993; Tanskanen *et al.*, 2000). This may be mediated through the central effects of nicotine (Tanskanen *et al.*, 2000). Japanese suicide victims with a history of smoking had higher levels of nicotine and cotinine in their blood and urine (Moriya and Hashimoto, 2005; Moriya *et al.*, 2006); the authors speculated that there may be a marked increase in smoking among habitual smokers before committing suicide. Second, depressed smokers may find it particularly difficult to quit smoking (Hemenway *et al.*, 1993; Sheikh, 2000). Third, other factors, including low self-esteem (Hemenway *et al.*, 1993) and alcohol and substance misuse (Phillips, 1992), may predispose to both smoking and suicide. Fourth, depressed patients may have a higher prevalence of smoking (Sheikh, 2000). Fifth, smoking and suicide may be linked to other disorders like cancer (Hemenway *et al.*, 1993; Sheikh, 2000); occult carcinomas may clinically present with depressive illness (Shah and De, 1998), and occult carcinomas

have been discovered at post mortem in elderly suicide victims (Catell, 1988). Finally, smoking may directly enhance suicidal behavior. There is evidence of serotonergic hypofunction in psychiatric patients with lethal suicidal behavior (Mann and Malone, 1997), and an inverse relationship between smoking and indices of serotonin function has been observed in psychiatric patients with depressive illness (Malone *et al.*, 2003).

Caution should be exercised in attributing a causal relationship and the direction of causality from this cross-sectional ecological study due to ecological fallacy. Nevertheless, the observed relationship between elderly suicide rates and smoking suggests that there is a need to confirm this relationship in the elderly in individual-level case-control or cohort studies. If such a relationship is confirmed then there will be a need to examine the explanatory mechanisms for this relationship.

### Conflict of interest

None.

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