



## Article

# International differences in the risk of death from smoking and obesity: The case of the United States and Finland



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## ABSTRACT

Despite much interest in the health risks associated with behavioral factors, little is known about whether individuals residing in different countries experience a different set of risks. International comparisons of the death risks from major behavioral factors can shed light on whether features of health systems and epidemiological histories modify the health effects of risky behaviors. We used nationally representative samples and mortality linkages spanning the 1971–2014 period from the United States and Finland to examine cross-national differences in the risks of death from cigarette smoking and obesity. We evaluated both current and former smoking and current and prior obesity. In 1990, the approximate midpoint of our study, the death risks from current smoking were about 55% higher in U.S. women compared to Finnish women, but similar for men in the two countries. Death risks from smoking significantly increased over the period for women in both countries and there was no parallel increase in risks among men. Death risks from obesity did not significantly differ in the two countries and no significant trend in the risks were detected in either country. Reasons for the relatively high and increasing risks from smoking among American women warrant further evaluation.

## 1. Introduction

Cigarette smoking and obesity exert large tolls on health in high-income countries (Mokdad, Marks, Stroup, & Gerberding, 2004; National Research Council, 2011). Since 1980, obesity levels have risen in nearly all parts of the world (Finucane et al., 2011). In 2013, approximately 20% of adults in high-income countries were estimated to be obese (defined as a body mass index (BMI)  $\geq 30$  kg/m<sup>2</sup>) (Ng et al., 2014a). The prevalence of cigarette smoking, in contrast, has generally been on the decline in high-income countries, at least since the 1970s (Pampel, 2010). Nonetheless, in 2012 approximately 30% of men and 20% of women in high-income countries were estimated to currently smoke cigarettes (Ng et al., 2014b). Many nonsmoking adults today have smoked in the past and the prevalence of current and former smoking combined exceeds 50% in many high-income countries (Zatoński, Przewoźniak, Sulkowska, West, & Wojtyła, 2012). Both obesity and smoking individually play a major role in explaining the low life expectancy ranking of the United States relative to European countries (National Research Council, 2011; Preston & Stokes, 2011)

and in contributing to within-country mortality differentials by socioeconomic status (Martikainen et al., 2014; Mehta, House, & Elliott, 2015; Stringhini et al., 2010).

We examined the question of whether individuals residing in different countries face a different risk of death from cigarette smoking and obesity using a comparative case of the United States and Finland. International comparisons can reveal whether risk factors are operating similarly on mortality under different circumstances. A comparative framework, for example, can provide insights into how features of health systems and cohort behavioral histories modify the riskiness of behavioral factors.

International comparisons are also valuable for studies evaluating the population-level number of deaths attributable to a behavioral risk factor because these studies often rely on estimates of death risks from the behavioral factor under investigation (Preston & Stokes, 2011; Rostron, 2011). In such studies, death risks are not always available for the country that is the focus of the investigation. It is not uncommon for studies to apply a set of risks from another country to estimate population-level attributable deaths in the country of interest (Gallus

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et al., 2011; Martelin, Mäkelä, & Valkonen, 2004; Neubauer et al., 2006; Preston & Stokes, 2011; Rodu & Cole, 2004). International comparisons of the risks can aid in assessing whether risks estimated from one dataset or country may be generalizable to other contexts.

In this study, we provide a specific comparison of the United States with Finland. Our comparison of the two countries is guided by theoretical and practical concerns. While both countries' GDP is higher than average for OECD nations, the United States is also characterized by higher levels of poverty and income inequality compared to Finland (OECD, 2016a, 2016b, 2016c). The countries also differ in their healthcare delivery systems and in their behavioral histories, which we review below. These contextual differences provide for an informative comparison. From a practical standpoint, both countries possess a long running series of nationally representative health surveys that contain information on socio-demographic and behavioral risk factors and that are linked prospectively to death records. These surveys and linkages date back to the 1970s in each country. Furthermore, surveys in each country contain information about body weight histories, which as we elaborate below, are useful in addressing key biases arising in the estimation of death risks from obesity. Body weight histories have been rarely collected in nationally representative surveys. All surveys also have information on past and current smoking behavior and socio-demographic characteristics of respondents.

### 1.1. The risks of death from cigarette smoking

The mortality risks from cigarette smoking have been recognized for over sixty years (Doll & Hill, 1954). These risks are usually ascertained from estimates made based on survey data that are linked to prospective death records. Recent estimates from a nationally representative survey in the United States applicable to the 1987–2003 period indicate that at age 65 current cigarette smokers face a risk of dying that approaches three times that of never smokers (Mehta & Preston, 2012). Studies from various European countries pertaining to various periods and adult ages report that smokers have a two- to three-fold higher death rate compared to never smokers (Doll, Peto, Boreham, & Sutherland, 2004; Prescott et al., 1998; Shavelle, Paculdo, Strauss, & Kush, 2008).

The estimated death risks from smoking appear to increase as the smoking epidemic evolves in a population. At least for the United States, there is evidence that the relative risks have been rising, perhaps since the 1960s. Thun, Day-Lally, Calle, Flanders, and Heath (1995) observed a rise in the relative risks from smoking among women between the 1960s and 1980s in the U.S. Cancer Prevention Study I (1959–1965) and II (1982–1986). Rising risks have also been observed in the United Kingdom (Doll et al., 2004; Pirie, Peto, Reeves, Green, & Beral, 2013), Japan (Sakata et al., 2012), and New Zealand (Hunt, Blakely, Woodward & Wilson, 2005). One explanation for these trends is that as the smoking epidemic evolves later birth cohorts begin smoking at an earlier age and more intensively than earlier birth cohorts (Mehta & Preston, 2012; Sakata et al., 2012; Thun et al., 2013, 1997a). Other explanations include changes in the tar and nicotine composition of cigarettes smoked (Jemal, Chu, & Tarone, 2001; Thun et al., 1997b) and social selectivity into smoking (Mehta & Preston, 2012). The latter refers to the fact that smoking has become more concentrated among those with low socioeconomic status (Mackenbach, 2006; Pampel, 2010).

Because the smoking epidemic evolved and receded at different times across countries (Pampel, 2010), it is likely that the death risks from smoking differ across countries. By international standards, U.S. men began smoking early with peak smoking occurring for the cohorts born around 1915–1920 (Preston & Wang, 2006). Finnish men also picked up smoking relatively early with peak smoking observed for the 1911–25 cohorts (Martelin, 1984; Martikainen, Ho, Preston, & Elo, 2013). In most countries, women tended to pick up smoking later than men with U.S. women being some of the earliest adopters. Peak

smoking occurred for U.S. women in the 1940–45 cohort (Preston & Wang, 2006) and for Finnish women in cohorts born in the 1950s (Martelin, 1984). While smoking began earlier in the United States compared to other high-income countries, it also declined faster (Cutler & Glaeser, 2006; Pampel, 2010). The national-level differences in smoking uptake and quitting also may influence cross-national differences in the relative risks of death from former smoking as they could imply cross-national differences in time since quitting, an important determinant of mortality among former smokers (Ho & Elo, 2013).

### 1.2. The risks of death from obesity

Compared to cigarette smoking, there is far less consensus about the magnitude of the death risks from obesity (Berrington de Gonzalez et al., 2010; Flegal, Kit, Orpana, & Graubard, 2013; Prospective Studies Collaboration, 2009). Estimates of the risks from obesity have varied widely with several studies indicating that risks are limited only to more severe levels of obesity (e.g., see Mehta & Chang, 2011a for a review). This uncertainty has resulted in uncertainty around estimates of the population-level impact of obesity such as the number of obesity-attributable deaths (Flegal et al., 2013; Mehta & Chang, 2009; Stokes, 2014).

Like that of cigarette smoking, estimates of the risk of death from obesity are normally based on observational studies and are subject to selection biases inherent in such studies. One major source of bias arises from the fact that illness often precipitates weight loss. The biases this ordering may cause is commonly referred to as “reverse causality” (although it is also referred to as disease confounding). If disease confounding is inadequately accounted for, it will normally result in downwardly biased risk estimates. These biases may be stronger at middle and older ages where disease prevalence is high compared to at younger ages. Adjustment for disease presence in statistical models or otherwise excluding individuals with pre-existing illnesses entirely from the analysis may not adequately account for this bias (Mehta, 2015).

Inclusion of a measure of weight status at an age prior to age at the time of the survey can be beneficial in fully characterizing the risks from obesity. When available, such information is typically obtained by asking survey respondents to report their body weight at earlier ages or times. A weight status measured earlier in life and well before the start of mortality follow-up is also likely to be more robust to reverse causality because it may be more reflective of life-long weight dynamics prior to the onset of weight loss induced by disease. Preston, Mehta and Stokes (2013) showed that among a U.S. sample of adults aged 50–74 at time of survey, BMI at age 25 was more strongly predictive of subsequent mortality than BMI present at the time of survey even when both variables were assessed simultaneously in a regression model. A similar finding was observed for Finnish adults by Mehta et al. (2014).

The selective and confounding processes that can bias estimates of the risks of death from obesity when BMI is measured at the start of the follow-up may operate to a different degree in different populations. This difference potentially complicates the interpretation of international comparisons of the risks of death from obesity. To account for this potentially important complication, we use survey data from Finland and the United States that include information on both current and retrospective reports of body weight, which allows us to compare estimates of the risks of death from high BMI pertinent to the start of the mortality follow-up and BMI pertinent to an earlier age. If the risks are similar across the estimates in the two countries, such a result would provide evidence for the proposition that underlying biological processes associated with obesity are responsible for the increased death risks rather than the result of selective confounding.

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