Social Science & Medicine 188 (2017) 128–136

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

The impact of education on the probability of receiving periodontal treatment. Causal effects measured by using the introduction of a school reform in Norway

Jostein Grytten*, Irene Skau

Department of Community Dentistry, University of Oslo, Oslo, Norway

ARTICLE INFO

Article history:
Received 19 April 2017
Received in revised form
17 July 2017
Accepted 19 July 2017
Available online 20 July 2017

Keywords:
Education
Causal estimates
Instrumental variable
Periodontal treatment
Observational data

ABSTRACT

The aim of the present study was to estimate the causal effect of education on the probability of receiving periodontal treatment in the adult Norwegian population. In Norway, a substantial part of the cost of periodontal treatment is subsidized by the National Insurance Scheme. In that case, one might expect that the influence of individual resources, such as education, on receiving treatment would be reduced or eliminated. Causal effects were estimated by using data on a school reform in Norway. During the period 1960–1972, all municipalities in Norway were required to increase the number of compulsory years of schooling from seven to nine years. The education reform was used to create exogenous variation in the education variable. The education data were combined with large sets of data from the Norwegian Health Economics Administration and Statistics Norway. Since municipalities implemented the reform at different times, we have both cross-sectional and time-series variation in the reform instrument. Thus we were able to estimate the effect of education on the probability of receiving periodontal treatment by controlling for municipality fixed effects and trend variables. The probability of receiving periodontal treatment increased by 1.4–1.8 percentage points per additional year of schooling. This is a reasonably strong effect, which indicates that policies to increase the level of education in the population can be an effective tool to improve oral health, including periodontal health.

1. Introduction

Periodontal disease is one of the most common chronic inflammatory diseases in humans. It was ranked as the sixth most prevalent disease in the Global Burden of Disease Study from 2010 (Kassebaum et al., 2014). The estimated prevalence is about 10% (Kassebaum et al., 2014; Jenkins and Papapanou, 2001; Petersen, 2003). At the individual level periodontal disease can lead to tooth loss, discomfort, masticatory dysfunction and poor nutritional status. Periodontal disease is also a burden on the healthcare economy, mainly due to the cost of treating the disease (Brown et al., 2002; PRNewswire, 2008; 2014).

Periodontal disease is due to the development of a pathogenic microbial biofilm at or below the margin of the gum (Chapple, 2014; Pihlstrom et al., 2005). In patients that are susceptible, this biofilm triggers an inflammatory immune response, which destroys the bone surrounding the teeth. Periodontal disease is associated with several chronic inflammatory diseases of ageing, such as atherogenic inflammatory disease, type 2 diabetes, rheumatoid arthritis, chronic kidney disease, obesity, and chronic obstructive pulmonary disease (Chapple, 2014; Pihlstrom et al., 2005).

When the disease is established, treatment is to remove the biofilm using manual or powered instruments, including biofilm debridement of periodontal pockets. In most cases, periodontal treatment, combined with good oral hygiene, is effective in reducing tissue inflammation and pocket depths, and in maintaining the attachment of the gum to the teeth (Hirschfeld and Wasserman, 1978; Drisko, 2001; Cobb, 2002; Pihlstrom et al., 1981). Periodontal treatment is also important for prevention of recurrence of the disease (Axelsson et al., 2004; Axelsson and Lindhe, 1981; Wennström et al., 1993; Becker et al., 1984; Morris et al., 2001; Fardal and Grytten, 2014).

Periodontal disease is more common among men than among women (Grossi et al., 1995; Albandar and Kingman, 1999; Shiau and Reynolds, 2010a). The reason for this difference is not clear. There

* Corresponding author. University of Oslo, P.O Box 1052 Blindern, N-0316 Oslo, Norway.
E-mail address: josteing@odont.uio.no (J. Grytten).

http://dx.doi.org/10.1016/j.socscimed.2017.07.011
0277-9536/

are at least two possible explanations (Shiau and Reynolds, 2010b; Genco, 1996). First, men usually have poorer oral hygiene than women and they have fewer preventive dental visits. Second, there may be genetic factors that contribute to gender differences in the prevalence of periodontal disease. This is supported by the results from studies that have shown that gender is associated with periodontal disease even after oral hygiene has been corrected for (Grossi et al., 1994, 1995). In a comprehensive review, Shiau and Reynolds (2010b) suggest that the sex difference is because “women seem to have a more responsive and protective cell-mediated and humoral immune response to antigenic challenges compared to males”. Different gene regulation, in particular differences in sex steroid-responsive genes, most likely play a major role (University of Maryland Baltimore, 2010).

An important policy goal is to make periodontal treatment available to everybody in need of such care (Jin et al., 2011). Ideally, the probability of receiving treatment should be independent of social determinants of health, such as education, income and living conditions. Several studies have found a positive association between socioeconomic status and the prevalence of periodontal disease (for a review see Schuch et al., 2016). To our knowledge there are no studies in which the relationship between socioeconomic status and the probability of receiving treatment has been examined.

The aim of the present study was to estimate the causal effect of education on the probability of receiving periodontal treatment in the adult Norwegian population. In Norway, a substantial part of the cost of periodontal treatment is subsidized by the National Insurance Scheme. In that case, one might expect that the influence of individual resources, such as education, on receiving treatment would be reduced or eliminated.

We were able to estimate the causal effect by using data on a school reform in Norway. During the period 1960–1972, all municipalities in Norway were required to increase the number of compulsory years of schooling from seven to nine years. The education data were combined with large sets of data from the Norwegian Health Economics Administration and Statistics Norway. Since municipalities implemented the reform at different times, we have both cross-sectional and time-series variation in the reform instrument. Thus we were able to estimate the effect of education on the probability of receiving periodontal treatment by controlling for municipality fixed effects and trend variables. We found that a higher level of education substantially improved access, measured as an increase in the likelihood of obtaining treatment.

Below we first briefly describe the background for the study – among other things the theory underlying using school reforms for identification of causal effects. We then describe the data and the empirical model. Finally, the results are presented and discussed.

2. Theory and background

An important focus of our study was to estimate causal effects. This is because a causal estimate can be used to make valid predictions about the consequences of a change in education. For example, does more schooling for people with poor dental health improve the probability of receiving treatment for periodontal disease? An association, typically estimated by ordinary least squares (OLS) regression, may not reflect a causal relationship (Grossman, 2006; Eide and Showalter, 2011; Listl et al., 2016). Such an association is likely to lead to biased results, mainly because the estimation does not take account of unobserved variables that are correlated with both education and treatment. Unobserved variables that are frequently cited in the literature are ability, place of residence, time preferences and morbidity (Grossman, 2006; Oreopoulos and Salvanes, 2011; Grossman and Kaestnar, 1997).

For example, smarter individuals may be more likely to obtain more schooling, and when necessary, to seek dental care, including periodontal treatment when necessary. Further, highly educated and wealthy individuals tend to live in affluent areas. These are also areas where the supply and quality of both schooling and dental services are likely to be high. Decisions about education and health involve trade-offs of different outcomes over time (Fuchs, 1982; Farrell and Fuchs, 1982). How does the individual trade off current outcomes over future outcomes? People with a strong preference for the future relative to the present are more likely to invest in education, and at the same time they are more likely to engage in healthier activities, such as having periodontal treatment. Conversely, people who value the present highly will invest less in both education and healthy activities, such as looking after their teeth. Therefore, time preferences must be controlled for (Ippolito, 2003; Van der Pol, 2011). As ability, place of residence and time preferences are positively correlated with both education and treatment, omission of these variables would lead to an upward bias of the OLS estimate. Morbidity is likely to be positively correlated with treatment and negatively correlated with education. Therefore, unless morbidity is taken account of by the identification strategy, the OLS estimate will be downward biased.

One way to control for unobserved variables is to use instrumental variables. So far, within the social science literature, the most promising type of instrumental variable has been the introduction of compulsory schooling laws (Eide and Showalter, 2011; Mazumder, 2012). Such laws were introduced in several European and North American countries in different time periods during the last century.

Typically, the effect of these laws was that the number of years of compulsory schooling was increased. In several countries, the number of years of compulsory schooling was increased from 7 to 9 years during the 1960s and the 1970s (Gathmann et al., 2015). The laws were implemented at a national level and encompassed all preschool children. The “treatment” group was then comprised of children with 9 years of compulsory education, and the “control” group was comprised of children with 7 years of compulsory education.

Several economists have used the random variation induced by the introduction of compulsory schooling to estimate causal effects of education on different types of health outcome measures (for example see: Lleras-Muney, 2005; Clark and Royer, 2013; Van Kippersluis et al., 2011; Fletcher, 2015; Braakmann, 2011; Lager and Torssander, 2012; Arendt, 2005; Kemptner et al., 2011; Grytten et al., 2014; Albuoy and Lequien, 2009; Auld and Sidhu, 2005). Such studies have been performed in the United States, Great Britain, the Netherlands and the Scandinavian countries. In several of the studies, but not all of them, a causal effect of education has been found (for a review see: Mazumder, 2012; Gathmann et al., 2015). For example, Oreopoulos (2007), using the introduction of compulsory schooling laws in the USA, Canada and the United Kingdom, found that an extra year of schooling at the age of 14 led to an increase in lifetime wealth of 15%, and to better mental and physical health. This was a consistent finding across all countries. Brunello et al. (2016) investigated the causal effects of education on different health measures in 7 European countries. They found that one additional year of schooling reduced self-reported poor health by 4–6 percentage points, and led to less smoking, less drinking and more exercise. Powdthavee (2010) claims that part of the beneficial effect of more schooling on health, is a reduction in individuals' stress level. This is supported by his finding that an extra year of schooling reduced the probability of having hypertension by nearly 10 percentage points. In a few studies, no causal effect of education on health has been found (Arendt, 2005; Albuoy and Lequien, 2009; Auld and Sidhu, 2005). In