SSM -Population Health 2 (2016) 333–340

Contents lists available at ScienceDirect

SSM -Population Health

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

Article

Can socioeconomic factors explain geographic variation in overweight in Norway?

Jonas Minet Kinge [a,b,*], Ólöf Anna Steingrímsdóttir [a], Bjørn Heine Strand [a,b], Øystein Kravdal [a,b]

[a] Norwegian Institute of Public Health (NIPH), Oslo 0170, Norway
[b] University of Oslo, Oslo, Norway

ARTICLE INFO

Article history:
Received 28 October 2015
Received in revised form
1 February 2016
Accepted 28 April 2016

Keywords:
Overweight
Body mass index
Socioeconomic factors
Neighborhood
Multilevel modeling
Geographic factors
Norway

ABSTRACT

We explore if the geographic variation in excess body-mass in Norway can be explained by socioeconomic status, as this has consequences for public policy. The analysis was based on individual height and weight for 198,311 Norwegian youth in 2011, 2012 and 2013, stemming from a compulsory screening for military service, which covers the whole population aged seventeen. These data were merged with municipality-level socioeconomic status (SES) variables and we estimated both ecological models and two-level models with a random term at the municipality level. Overweight was negatively associated with income, education and occupation at municipality level. Furthermore, the municipality-level variance in overweight was reduced by 57% in females and 40% in males, when SES factors were taken into account. This suggests that successful interventions aimed at reducing socioeconomic variation in overweight will also contribute to reducing the geographic variation in overweight, especially in females.

1. Introduction

Worldwide, the proportion of overweight adults has increased from 29% among men and 30% among women in 1980 to 37% and 38%, respectively, in 2013 (Ng et al., 2014). Every second type II diabetes case, every fifth ischemic heart disease case and more than every third of certain types of cancers are attributable to excess body weight (WHO, 2000). The rise in overweight is not only limited to developed countries; overweight is now a problem among all age groups in developing countries as well (Ng et al., 2014).

There are considerable geographic variations in overweight within many countries. In Norway, the share of youth considered overweight varied between 14.8% and 28.3% across the 19 counties in 2013 (Norwegian Institute of Public Health, 2015). Like the geographic variation in other health outcomes, such geographic variations in overweight has received considerable attention and puzzled researchers, politicians and policy makers (Bjerkedal & Brevik, 2001; Department of Health (UK), 2004; Jullumstro & Eide, 2013; Norwegian Ministry of Health and Care Services, 2012; Smyth, 2015). Some countries have also introduced measures to reduce geographic variation in health. For example, in the UK the Government has set a Public Service Agreement target to address geographical inequalities in life expectancy, cancer, heart disease, stroke and related diseases (Department of Health, 2004). Also in Norway the municipalities, which are responsible for local public health, are obliged to keep an eye on geographical differences and suggest interventions when needed (Norwegian Ministry of Health and Care Services, 2012). However, an important question is whether steps could or should be taken to reduce the geographic variation in overweight, and the answer depends on the type of factors that contribute to it.

The aim of this paper is to contribute to this discussion by estimating how much of the geographic variation in overweight in Norway is explained by three indicators of socioeconomic resources (income, education, and occupational status), which in a number of studies have been associated with overweight. More specifically we estimate multilevel models with a random term at the municipality level and study how its variance is reduced when SES indicators are added. To our awareness such a study has not been carried out in any country earlier.

If socioeconomic factors contribute substantially to geographic variation in overweight, the implication is that reduction of SES variation in overweight – which is an important health policy goal in Norway and many other countries – will also reduce the geographic variation. For example, nationwide income

* Corresponding author at: Norwegian Institute of Public Health, Pb 4404 Nydalen, 0403 Oslo, Norway.
E-mail addresses: Jonas.Minet.Kinge@fhi.no (J.M. Kinge), OlofAnna.Steingrimsdottir@fhi.no (Ó.A. Steingrímsdóttir), BjornHeine.Strand@fhi.no (B.H. Strand), oystein.kravdal@econ.uio.no (Ø. Kravdal).

http://dx.doi.org/10.1016/j.ssmph.2016.04.010

supplementation to relatively poor people or general initiatives to reduce school dropout would also reduce the geographic variation. Conversely, if SES does not explain much of the geographic variation in overweight, it must be the result of other factors such as other individual characteristics (e.g. attitudes), neighborhood green space (Astell-Burt, Feng, & Kolt, 2014), or other aspects of the environment (unchangeable or man-made) not entirely determined by the SES of the population (e.g. fast food restaurants). Interventions to reduce the geographic differences would then have to be different from interventions aimed at reducing socioeconomic health inequalities.

We consider the socioeconomic resources in the municipality, indicated by average income, average education and occupational status. Information about corresponding individual level characteristics are not available. The associations between municipality-level socioeconomic resources and an individual's overweight will reflect two effects: first, own (or, for young people, parents') SES may have an impact on an individual's weight; second, there may be an effect of the SES in the municipality on individual weight. As explained below, separation of those two contributions would be of some value from a policy perspective, but the data available to us did not allow this.

2. Data and methods

2.1. Data

Our study was based upon individual-level (but anonymized) data on height and weight of the Norwegian youth in 2011, 2012 and 2013. Height and weight was self-reported and supplied in an internet based military muster from the Norwegian Armed Forces. Since 2010 it has been compulsory for Norwegian citizens to provide this information, as part of a large questionnaire during the year they turn 17 (Fauske, 2011). Hence, the response rate is as high as 97%[1]. Individuals who become Norwegian citizens after the age of 17 years and individuals who do not finish school on time can fill out the form at an older age. We excluded all individuals who were over the age of 18 when answering the questions about height and weight (1.3% of females and 3.5% of males). Our study population comprised 90,568 females and 107,743 males[2]. We also have access to information about the individual's municipality of residence.

2.2. Variables

The dependent variable was overweight, defined as the body mass index (BMI, weight in kilograms divided by height in meters squared) being above 25 in adults. This limit accords with World Health Organization guidelines (World Health Organization, 1995). However, body mass changes substantially with age and our population consisted of individuals aged 16-18. Hence, we used age- and sex-specific overweight cut-off values to account for changing interpretation of BMI by age and sex in younger age groups (Cole, Bellizzi, Flegal, & Dietz, 2000).

The level of aggregation was the Norwegian municipalities, as defined the 1st of January 2014, and the analysis encompassed all 428 municipalities in the country. As recommended by Galobardes, Lynch, and Smith (2007), we included three aggregate measures to reflect the socioeconomic conditions in the area.These are median gross income in 2012, the share of the population above the age of 16 with college or university education in 2012, and the share of the population aged 15–74 who were in leading positions[3] in 2012. A number of previous studies have demonstrated that the associations between income and health behaviors are non-linear (Ecob & Smith, 1999; Ettner, 1996), so we grouped the income variable into five categories.

As covariates we also include the share of the population aged 16–66 and the square root of the population size[4]. The reason for including population size is that it is a reasonable indicator of the degree of urbanity, which is positively associated with income. Living in an urban area has also been found to be negatively associated with the prevalence of overweight (Biehl et al., 2013). The age structure may affect the share of the population who are employed, and thus the average income in the population. Additionally, BMI tends to vary by age (Flegal, Carroll, Kuczmarski, & Johnson, 1998), which then again may have an impact on our sample through peer-effects (Trogdon, Nonnemaker, & Pais, 2008).

It is likely that the effects of socioeconomic factors on overweight may vary across the sexes. The possibility of such variation has rarely been analyzed from a multilevel perspective (Wen & Maloney, 2014). A few studies have indicated that women, on the whole, may be more influenced by area-level contexts than men (King, Kavanagh, Jolley, Turrell, & Crawford, 2006). However, other studies have found stronger associations between composite measures of neighborhood disadvantage and mortality among men than among women (Kravdal, 2010). We ran a Chow test based on a logit model and found that the coefficients (both at the individual- and area-level) varied significantly by sex. This further supports sex-stratified analyses.

Finally, we controlled for 1-year age groups at the individual level and response year.

2.3. Statistical analysis

In the first step, we generated descriptive graphs of the associations between overweight prevalence in the municipality and the three socioeconomic variables, based on locally weighted regressions with a bandwidth of 0.8 to place less emphasis on the outliers.

In the second step, we estimated two-level logistic models, where the dependent variable was the binary overweight variable at the individual level. The models were of the form:

$$\text{Log}\,it(y_{i,j}) = \alpha_0 + \alpha_1 A_{i,j} + \alpha_2 T_{i,j} + \alpha_3 X_j + \zeta_j \quad (1)$$

where i indexes the individuals, j indexes the 428 municipalities, y is the overweight status for individual i in municipality j, A is the age group, and T response year. X is a vector of the municipality-level variables. ζ_j is a random intercept which is assumed to be independent across municipalities' j and independent of the other covariates in the models. The variance of this random term is a measure of the between-municipality variation in the dependent variable, which is not explained by the variables included in the model. We estimate the proportional change in the variance (PCV) by the formula (Merlo et al., 2006):

[1] This number was obtained from personal communication with staff at the Norwegian Armed Forces.

[2] A few individuals answered the question about height and weight twice (at 17 and 18). However, we do not have the opportunity to correct for this in our data. To check whether or not this has an impact on our results we reran the analysis, excluding those who are 18. It does not alter the findings and we kept the 18-year olds in our analyses.

[3] Leading positons are here defined according to the Norwegian Standard for Classification of Occupations (STYRK). All codes that start with the number 1 are leading positions or politicians.

[4] Some of the data used in this publication are based on the Norwegian Social Science Data Services Municipality Database. The Norwegian Social Science Data Services is not responsible for data analysis or interpretation done here.