Economics and Human Biology 31 (2018) 1–13

Contents lists available at ScienceDirect

Economics and Human Biology

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

The health care costs of childhood obesity in Australia: An instrumental variables approach

Nicole Black[a,*], Robert Hughes[a], Andrew M. Jones[a,b]

[a] Centre for Health Economics, Monash Business School, Monash University, Australia
[b] Department of Economics and Related Studies, University of York, United Kingdom

ARTICLE INFO

Article history:
Received 25 January 2018
Received in revised form 16 July 2018
Accepted 16 July 2018
Available online 23 July 2018

JEL classifications:
I1
I12
I18
C26

Keywords:
Medical costs
Child
Ren
Overweight
Obesity
BMI
Instrumental variable

ABSTRACT

The effect of childhood obesity on medical costs incurred by the Australian Government is estimated using five waves of panel data from the Longitudinal Study of Australian Children, which is linked to public health insurance administrative records from Medicare Australia. Instrumental variables estimators are used to address concerns about measurement error and selection bias. The additional annual medical costs due to overweight and obesity among 6 to 13 year olds is about $43 million (in 2015 AUD). This is driven by a higher utilisation of general practitioner and specialist doctors. The results suggest that the economic consequences of childhood obesity are much larger than previously estimated.

1. Introduction

Childhood obesity is considered one of the most serious public health challenges of this century. One in four Australian children are overweight or obese, with many high income countries experiencing similarly high prevalence rates (OECD, 2014). Childhood obesity is concerning not only because of the high risk of persistence into adulthood, but also the elevated risk of serious health conditions during childhood. These conditions include asthma, sleep apnea, bone and joint problems, hypertension, high cholesterol, type 2 diabetes and psychological problems (Reilly et al., 2003; Daniels, 2006). Given a majority of health expenses in Australia are funded by the public purse (AIHW, 2016), Australian policy makers are particularly interested in the medical costs attributable to obesity. Information on such costs not only allow health insurers to predict future health care expenses, but they also provide evidence that is needed for assessing the short-term value to governments and the wider society of childhood obesity prevention and treatment programs.

Over the past decade, several studies have examined the health care costs associated with childhood and adolescent overweight and obesity (e.g. Johnson et al., 2006; Monheit et al. 2009; Breitfelder et al., 2011; Au, 2012; Wenig, 2012; Turer et al., 2013; Batscheider et al., 2014; Wright and Prosser, 2014; Clifford et al., 2015). A majority of studies find obesity in childhood or adolescence to be correlated with higher health care expenses.[1] While informative, one limitation of previous studies is that they are unable to infer causality; that is, to determine the costs that are attributable to obesity, and not merely associated with obesity.

There are three potential reasons why ordinary least squares (OLS) estimates of the costs of obesity may suffer from bias: i) omitted variables; ii) reverse causality; and iii) measurement error. The direction of bias due to omitted variables (or unobserved confounders) is *a priori* unclear. For example, unobserved factors

* Corresponding author at: Centre for Health Economics, Monash Business School, Monash University, Level 2, 15 Innovation Walk, Clayton VIC 3800, Australia.
E-mail address: nicole.black@monash.edu (N. Black).

[1] An insignificant correlation has been reported by a few studies using the Medical Expenditure Panel Survey (MEPS) in the United States (Skinner et al., 2008; Turer et al., 2013; Wright and Prosser, 2014)

https://doi.org/10.1016/j.ehb.2018.07.003
1570-677X/

(such as poor parental health literacy or geographically remote neighbourhoods) may be correlated with both a higher likelihood of obesity and with lower utilisation or access to health care services among children. This would imply a negative selection bias and an underestimate of medical costs caused by obesity. Similarly, unobserved medical conditions such as cancer or autoimmune diseases (e.g. celiac disease) could explain both a lower likelihood of obesity (Collins et al., 2000; Fasano and Catassi, 2005) and a greater utilisation of health care. On the other hand, there may be a positive bias if other medical conditions (such as depression or anxiety) lead to both an increase in weight (e.g. through emotional eating or medication side-effects) and health care utilisation.

Reverse causality (or simultaneity bias) may occur if a visit to the doctor results in a treatment program or drug that affects the child's weight. The direction of bias resulting from this could go in either direction. Finally, measurement error, which can arise if a child's adiposity is measured imprecisely, is concerning because it can lead to an underestimate of the costs caused by obesity. Previous studies examining the consequences of obesity have traditionally recognised that using body mass index (BMI) that is derived from self- or parent-reported height and weight may suffer from measurement error. This is not a concern in our study as we use BMI derived from clinically measured height and weight. However, we raise another source of measurement error in BMI, which arises due to the normal changes in weight relative to height as children grow and physically mature (Horlick, 2001). Such short-term fluctuations imply that BMI measured at any one point in time may not accurately reflect a child's adiposity; increases in BMI may be due to both increases in fat mass and fat-free mass (Lindsay et al., 2001; Maynard et al., 2001; Freedman et al., 2004).

This study aims to address these potential biases by employing an instrumental variables (IV) estimator to determine the effect of childhood obesity on health care costs incurred by the Australian Government. We build on recent studies that have used an IV approach to determine the impact of obesity on health care utilisation (Cawley and Meyerhoefer, 2012; Biener et al., 2017; Doherty et al., 2017; Kinge and Morris, 2017). Cawley and Meyerhoefer (2012) estimate the medical costs caused by adult obesity in the United States using the weight of a biological relative as the instrumental variable. They show that the estimated effect of adult obesity on medical costs is much greater than previous non-IV estimates suggested. Using the BMI of biological parents as instruments for child's BMI, Kinge and Morris (2017) find that childhood obesity increases the probability of a doctor visit and medications usage in England. Doherty et al. (2017) using the biological mother's BMI as an instrument, find that in Ireland, obesity increases the probability of a GP visit and hospital stay among adolescents. Biener et al. (2017) also instrument for child's BMI using the biological mother's BMI and find that obesity increases medical costs in the United States to a much larger extent than previously estimated.

Our study uses a similar approach to investigate the causal effects of childhood obesity on publically-funded health care costs in Australia. We use the body mass index (BMI) of the child's biological parents to instrument for the child's BMI. A key strength of this study is the use of panel data on a representative sample of Australian children, with measured height and weight of each child linked to government administrative records on the child's health care utilisation and costs. We ensure that health care costs are incurred after weight is measured to reduce reverse causality concerns, and utilise the richness of the dataset to control for a wide range of child and parental characteristics that may influence health care seeking behaviour. In addition, we provide new insight into the longer-term costs attributable to childhood obesity by investigating how a higher BMI at age 6/7 affects health care costs over the next eight years that follow.

We find that a heavier BMI significantly increases the total health care costs incurred, and the effect is considerably higher than the estimated association using ordinary least squares. Falsification tests using BMI of step-parents support the validity of the instrumental variables, and robustness checks using information on a range of health conditions provides additional support for our instruments. We show that the increase in health care costs is largely driven by higher general practitioner and specialist visits, and is not due to mental health, dental, pathology, diagnostic or other services. Our estimates suggest that overweight and obesity in children aged 6 to 13 cost the Australian government approximately $43.2 million annually (in 2015 AUD) over and above the costs for children of normal weight for non-hospital health care services. This indicates that the short-term economic consequences of childhood obesity arising from health problems alone is considerable and a failure to take this into account in economic evaluations of obesity reduction programs may lead to a substantial underestimate of the economic returns from investing in such programs.

2. Data

2.1. The Longitudinal Study of Australian Children

The Longitudinal Study of Australian Children (LSAC) is a biennial representative panel survey of Australian children, which began in 2004 (see Soloff et al., 2005, for a detailed description of the study design). Briefly, postcodes were stratified by Australian State/Territory and by metropolitan and nonmetropolitan area. Postcodes from each strata were randomly selected, and within each postcode, children in the required age cohort were randomly selected from the Medicare enrolment database. Only one child per family was eligible for inclusion in the sample. This study uses data from the first five waves (2004 to 2012) of children from Cohort K, who were aged 4–5 years in the first wave. Of the original Wave 1 sample, the response rate for Waves 2, 3, 4 and 5 was 90%, 87%, 84% and 79% respectively, which is similar to other longitudinal studies of children (such as the Millennium Cohort Study in the U.K.). Data on the child and their family's social circumstances were collected through a face-to face interview with the child's primary carer. More sensitive information from the parents was collected using self-completion questionnaires.

Physical measurements of the child's height and weight were taken during the interview using digital scales and a stadiometer. These were used to calculate the child's BMI $(kg/m)^2$. In the main analyses, BMI z-scores, based on CDC growth charts (Kuczmarski et al., 2002) are used. BMI z-scores are more flexible than binary indicators of BMI categories, and still allow us to make health care cost predictions in terms of children who are overweight or obese. We test for non-linearity in the relationship between BMI z-scores and health care costs by including squared terms. For the descriptive analyses, children are categorised into underweight, normal weight, overweight and obese using international age- and gender-specific cut-points (Cole et al., 2000).

Because our approach utilises the height and weight of both biological parents in wave 1, the main sample is restricted to 3458 children who have biological parents with height and weight information at wave 1 (69% of total sample).[2]

[2] Wave 1 contains the most complete information on the BMI of biological parents, so the use of wave 1 BMI allows us to maximise sample size. In a sensitivity analysis, we use only the biological mother's BMI from wave 1, which allows us to further increase the sample size to 3955 children.