Invited Commentary

Invited Commentary: Methods for Estimating Effects of Minimum Wages on Health

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Economists have been researching effects of minimum wages on unemployment, poverty, income inequality, and educational attainment for over 60 years. Epidemiologists have only recently begun researching minimum wages even though unemployment through education are central topics within social epidemiology. Buszkiewicz et al. (*Am J Epidemiol*. 2020;000(0):000–000) offer a welcome addition to this nascent literature. A commanding advantage of Buszkiewicz et al.'s study over others is its distinction between a "likely affected" group comprised of workers with ≤12 years of schooling versus "not likely affected" groups with ≥13 years of schooling. But there are disadvantages, common to other studies. Buszkiewicz et al. use cross-sectional data; they include the self-employed as well as part-time and part-year workers in their treatment groups. Their definitions of affected groups based on education create samples with 75% or more of workers who earn significantly above minimum wages; definitions are not based on wages. Inclusion of workers not subject to (e.g., self-employed) or affected by minimum wages biases estimates toward the null. Finally, within any minimum wage data set, it is the state—not federal—increases that account for the lion's share of increases and that form the natural experiments; however, state increases can occur annually whereas the development of chronic diseases might take decades.

difference-in-differences; labor economics; minimum wage; social epidemiology

Abbreviations: NHIS, National Health Interview Survey; DD, difference-in-differences; DDD, difference-in-difference-in-differences.

Economic research suggests that stagnant and falling wages for middle- and low-wage workers have been features of the US economy for over 40 years and have been fueling rising income inequality (1). Epidemiologic research finds that income inequality, in turn, has powerful effects on public health (2). Recently, the economists Case and Deaton (3) found alarming increases in deaths from drug overdoses, liver cirrhosis, and suicides since the mid-1990s, especially among middle-aged people. Case and Deaton (3) suggest these "deaths of despair" result, in part, from stagnant and falling wages caused by the decades-long erosion in the number of well-paying, blue-collar jobs, primarily in the Midwest and coal country. The Centers for Disease Control and Prevention (CDC) (4) cite increases in "deaths of

despair" as one of the likely causes of the stunning decline in US life expectancy from 2014 to 2017, a decline the United States has not experienced since the 1918–1920 influenza pandemic. Finally, Monnat (5) and Blanchflower (6) found that "deaths of despair" and falling wages since the Great Recession contributed to the election of Donald Trump and vote for Brexit.

Minimum wages are frequently suggested as policies to increase wages, especially among low-wage workers, and reduce income inequality (7). Research into the economic effects of minimum wages on, for example, unemployment, work hours, poverty, and educational attainment, is mountainous. Even though employment through education are regarded as social determinants of health, research into

the public health effects of minimum wages is minuscule although expanding rapidly (8). The study by Buszkiewicz et al. (9) is a welcome addition to this nascent literature.

TRY TO MIMIC A RANDOMIZED TRIAL

There are no randomized trials involving minimum wages; the best studies nevertheless attempt to mimic them with natural experiments. Ideally, a treatment group consists of only those workers who receive changing minimum wages and the control group of similar workers who do not. The best studies for short-term effects use longitudinal data on both groups before and after the minimum wage is changed, typically meaning it is raised. (The inflation-adjusted minimum wage can fall over time). The before-and-after difference in a health outcome in the treatment group is compared with the same difference in the control group using the difference-in-differences (DD) design. John Snow pioneered the DD design when he compared differences in cholera deaths before and after the water pump handle was removed in one district with another district that kept the handle. The first challenge is to identify treatment and control groups as close to the ideal as possible. The second challenge is to identify "similar" workers. In my view, 3 studies come closest to meeting these challenges; all are from the UK and all use longitudinal data in the British Household Panel Survey. In 1999, the UK established its first-ever national minimum wage of at least £3.60/hour. One of Reeves et al.'s (10) methods is typical of these studies. Reeves et al. divided groups by firms that complied with the new law (treatment group) versus firms that did not comply (control). All identified workers were eligible—all had wages below the minimum in 1998—but only workers in the treatment group received the raise in 1999. Reeves et al. (10) used the DD design and found positive effects on mental health, equivalent to those of antidepressants. Lenhart (11) found improvements in subjective health status and reductions in smoking prevalence. Kronenberg et al. (12) could not reject the null pertaining to effects on mental health.

US STUDIES

For all US studies, treatment groups include workers living in states experiencing minimum wage increases in certain years and control groups include workers living in states without increases. But these US groups are far from ideal, in part because most workers in treatment groups likely did not receive minimum wage increases due to these studies' definitions of affected workers. Moreover, with one exception, no US study used longitudinal data or identified groups based upon wages. The exception uses annual data, 1997–2013, from the Panel Study of Income Dynamics and, in some analyses, considers workers earning ≤1.2 times the minimum wage (13). Although most workers in this wage-defined treatment group likely receive the new wage, some might not have. Du and Leigh (13) found that increases in minimum wages reduced sickness absence.

The best US studies, in my view, distinguish between "likely affected" and "not likely affected" groups within both treatment and control groups, as Buszkiewicz et al. (9) did. Poorly designed studies do not make these distinctions and implicitly assume that workers making, for example, $50 per hour are affected by an increase in the minimum wage from $7.25 to $8.25 (8). But effects above the 50th percentile of the wage distribution are highly unlikely (7). Buszkiewicz et al.'s "likely affected" group includes those with ≤12 years of schooling and "not likely affected" groups with either ≥13 years of schooling or only 13–15 years. Buszkiewicz et al. have additional admirable data and methodological features. Their data, the National Health Interview Survey (NHIS), are highly regarded, contain large samples, and, as far as I know, no "minimum wage and health" study has used them. Buszkiewicz et al. considered 5 health outcomes, including diabetes, a heretofore unresearched outcome. Buszkiewicz et al. considered both current and 2-year lags under the assumption that minimum wages could have immediate or delayed effects. They adjusted estimates for multiple comparisons, which while commonplace in epidemiology is rare in economics. Economists might argue that there is only one hypothesis: Do minimum wages affect health? They would look for the preponderance of evidence across all health measures. Epidemiologists might argue that there are multiple hypotheses across outcomes (e.g., behavior such as smoking vs. health such as hypertension) and/or populations (e.g., blacks vs. whites or teenagers vs. adults). Buszkiewicz et al., in fact, test for differences across race/ethnicity and sex categories. Unlike some other studies, Buszkiewicz et al. exclude people not in the labor force, such as retirees.

Finally, Buszkiewicz et al. (9) use the difference-in-difference-in-differences (DDD) design. The first difference is the difference in health outcomes across states, and the second difference is across different time periods. The third considers whether the second differences are different for "likely affected" versus "not likely affected" groups. This third difference arguably controls for unobserved state-level changes possibly occurring simultaneously with minimum wage increases. The only 3 published US studies that use both DD and DDD of which I am aware find consistent results for both, as do Buszkiewicz et al. (9, 13–15)

DEFICIENCIES IN BUSZKIEWICZ ET AL. (9) AND OTHER SIMILAR STUDIES

First, Buszkiewicz et al. (9) used cross-sectional data, thereby undermining their ability to find causal effects. Second, perhaps 75% or more of their "likely affected" group would not be affected by minimum wages. Like most authors, they define "likely affected" by education, not wages. According to the Bureau of Labor Statistic, in 2017, "Among hourly paid workers age 16 and older, about 4 percent of those without a high school diploma earned the federal minimum wage or less, compared with about 2 percent of those who had a high school diploma (with no college) . . . " (16). Lenhart (15) reports that only 24% of his sample of "high school or less" earned ≤1.1 times the effective (state or federal) minimum wage. If only small

percentages of "likely affected" samples are truly affected, estimates will be biased toward zero.

The NHIS employment question has limitations. No information is provided on self-employment or employment as domestics or farm workers, but the self-employed are never covered by minimum wage laws, and domestics and farm workers rarely are. The Bureau of Labor Statistics estimates that 10.1% of the workforce is self-employed (17). In addition, as the authors acknowledge, no NHIS questions provide information on part-time or part-year employment. Buszkiewicz et al. (9) report that "about 65% of minimum wage workers work part-time hours." The Bureau of Labor Statistics reports that approximately 20% of both full-time and part-time workers work less than year-round (18). Any effect of minimum wages arguably would be more difficult to find among part-time, part-year workers than full-time, year-round workers because total earnings would be less for the former; their inclusion in the samples bias estimates toward the null. Studies that have restricted attention to full-time, year-round workers generally find salubrious effects (8). Finally, the NHIS does not have information on wages so their "likely affected" sample cannot be defined as, for example, ≤ 1.2 times the minimum wage.

Buszkiewicz et al. (9), wisely in my view, perform separate analyses on samples of only employed workers in some tables; their central null findings are supported. To the extent that minimum wages have effects, they would more likely be apparent in samples of employed than unemployed people. Unemployed people might be affected if their unemployment resulted from an increase in minimum wages, but the vast majority of unemployed people during the time of their study (2008–2015) were unemployed due to the Great Recession. Moreover, since the landmark study by Card and Kreuger (19), economists strongly question whether moderate increases in minimum wages cause any unemployment. Even David Neumark (20), the leading Card and Kreuger (19) critic, estimates minimal effects: 10% increases in minimum wages create 1.5% decreases in numbers of workers with minimum wage jobs; if 100 minimum wage workers are employed before the increase, then 98–99 will be employed after it. Most importantly, Neumark's estimates do not apply to the more than 90% of the workforce that do not have minimum wage jobs. Future researchers who include the unemployed should include a covariate for state unemployment to account for non-minimum-wage effects on unemployment (Buszkiewicz et al. (9), Web Table 3) (21).

Buszkiewicz et al. (9) and most other authors do not explore the theoretical pathways whereby minimum wages affect health. For example, wages might affect job satisfaction and satisfaction might affect health (8).

ADDITIONAL METHODOLOGICAL CHALLENGES AND FUTURE RESEARCH

Additional methodological challenges pertain to the choice of health outcome and short- and long-term effects. There is no single metric for measuring health. Buszkiewicz et al. (9) consider several. But not all measures are equal. In-creases in minimum wages happen within 1 year; decreases in inflation-adjusted minimum wages happen over many years or decades. Accordingly, behaviors such as smoking, acute diseases, injuries, suicides, and birth weights for infants whose mothers hold minimum wage jobs might be better measures for testing annual increases. Chronic diseases such as hypertension or diabetes might be better for longer-term effects. Virtually all existing US minimum wage–and-health studies implicitly test for annual effects with their emphasis on year-to-year, state-level changes over fewer than 9 years. This is appropriate given that we want to easily measure unambiguous changes in treatments on outcomes, and we also want to minimize effects of migration across states that could occur in the long run. A literature review of these short-run studies found only declines in smoking—among more than 20 outcomes—with consistent findings across several studies (8). A short-run study conducted after the literature review finds effects on reducing suicides (21). Long-run effects might be difficult to measure but might be more important. Case and Deaton (3) emphasize decades-long wage declines for "deaths of despair." A long-term, DD design will face challenges, however; for example, longitudinal data will be difficult to obtain, and migration and attrition will introduce significant biases.

Future research could use the "contiguous counties or regions" method introduced by Card and Krueger (19), who compared data from western New Jersey (Camden, Newark) with eastern Pennsylvania (Philadelphia) after an increase in New Jersey's minimum wage. Many economists argue that the "contiguous counties or regions" method is superior to state-by-state comparisons, because the latter allow too much geographic variability; prevailing wages and employment conditions are vastly different in Fresno versus San Francisco, yet both are in California. In economics, the "contiguous" method has expanded rapidly since 1995, and virtually all studies find that minimum wages do not affect employment (22, 23). I am aware of only 1 health study that uses the "contiguous" method. Jalali (24) found that increases in minimum wages reduced infant mortality. Future research might also consider using longitudinal data; testing for long-term effects; restricting attention to full-time, year-round workers; including teenagers, young adults, and adults in separate analyses; and using wages to define affected groups.

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