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Income windfalls and overweight: evidence from lottery wins

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Abstract
We examine the impact of an income windfall (from a lottery win) on an individual's overweight and Body Mass Index (BMI). We use longitudinal data from the United Kingdom, where a large proportion of the population plays the lottery, and retrieve income effect estimates using time and individual specific fixed effects alongside a set of relevant controls. Although our findings suggest any income windfall may lead to a contemporaneous increase in overweight, we document evidence that a £1,000 win reduces the probability of overweight in the range by up to 3 percentual points 12 months after the lottery win. Estimates are heterogeneous across working hours and educational attainment. A £1000 lottery win reduces the risk of overweight among low educated individuals by 4.5–5 percentual points (pp)12 months after the lottery win.

Keywords Obesity · Overweight · Income · Windfall income · Lottery wins · Body mass index (BMI)

JEL Classification I12 · I18 · J30

1 Introduction

In examining the determinants of health production, economists need to bear in mind that both individuals' monetary and time budgets are constrained, and so are the opportunities to invest in healthy behaviours. Hence, when household income expands after increased working hours, it might not always result in improvements in an individual's health outcomes such as overweight and obesity (Costa-Font and Sanez de Miera

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Juarez, 2022).[1] Existing research has shown that earned income and other measures of socioeconomic status (SES) are associated with a higher likelihood of being overweight (Sallis et al. 2009). However, the interpretation of the estimates of earned income on overweight is far from trivial, as it captures the effect of returns to educational investments, alongside other potential confounders.[2] Indeed, estimates of individual earned income over time carry the effect of differences in work effort as well as returns to human capital investment in additon to pure 'income effects' (Cutler and Lleras-Muney 2010; Kenkel 1991), all of which might have separate and independent effect on health outcomes.

Maintaining a healthy weight may be a luxury good in settings where individuals face high costs of some health investments (e.g., consumption of fresh foods, gym membership, access to housing in healthy environments) or, face barriers to the access to some types of health care in the event of illness (Cheng et al. 2018). In addition to affordability effects, higher income individuals might exhibit different reference points about their overweight status due to a more privileged environment, including a easier access to health information (Caporale et al. 2009). As a result, it is critical to distinguish between the effect of earned from unearned income in examining the causal effect of income on individual's overweight. One way to identify income effects alone is to exploit evidence from an exogenous variation in an individual's household income after a lottery win. This is the main purpose of this paper.

This paper exploits the income effects resulting from a lottery win on individual's overweight. Given that lottery wins are orthogonal to an individual's health-related choices, we expect our estimates to identify the effect of income on overweight. We use data from the United Kingdom (UK), and more specifically the British Household Panel Study (BHPS) which collects individual level information on different sources of income, including lottery wins, as well as information on weight and height. We do not include the UK Household Longitudinal Study (UKHLS) sample as it would reduce the longitudinal sample to a smaller number of households followed from the BHPS survey. However, the inclusion of many covariates and the use of longitudinal data mitigates the risk of capturing alternative channels that are unrelated to income and time constraints. That is, some specifications control for other determinants of overweight such as education which can influence access to health information, and other covariates. Furthermore, we consider a number of heterogeneous effects on income, education, gender and working conditions.

We contribute to a growing body of research on the impact of income on the likelihood of being overweight. Our study is closer to Cawley et al. (2010), which exploits evidence of a reform in the US social security "notch", namely an exogenous variation of otherwise identical individual's income which exogenously changed age specific retirement entitlements. They document no effect of income shocks on overweight and obesity. However, it can be argued that such individuals are exposed to different incentives to stay on a healthy weight compared to younger cohorts. Hence, a lingering question is whether the effect of such income changes can be extended to

[1] As individuals take up different work tasks, they might follow reference points when their income changes due to job promotions (Costa-Font and Ljunge, 2018).

[2] For instance, Sobal and Stunkard (1989) reviewed the literature and found that whilst obesity is associated to female SES it is not associated on male SES.

the entire population. An alternative method for studying the behavioral reaction to windfall income is to examine the effect of lottery wins. Unearned income can have a significant impact on health behaviours because it involves an unexpected shift in an individual's budget constraint without affecting work hours, cognitive effort, or the likelihood of receiving a bequest. The significance of looking at lottery wins stems from the fact that the causal effect of income shocks on overweight may differ depending on the source of income shock. Indeed, a reduction in social security income or an unexpected bequest can be anticipated, and hence exert other effects on the household. Furthermore, it is possible to argue that social security payments are not perceived as a "windfall", and recipients may simply adjust to slightly higher regular consumption.

A large body of literature has already investigated the impact of income shocks such as lottery wins on food consumption (Blundell and Pistaferri 2003; Guo et al. 2000). One of the consequences of lottery wins is a reduction in an individual's working times (Picchio et al. 2015).[3] Hence, we examine whether the effect is driven by a reduction in individuals' working hours. That is, lottery winners could experience a weight increase if they were time poor. [4]

This paper adds to the body of knowledge in the following ways. First, it advances the field by examining the effect on overweight of exogenous income fluctuations brought about by changes in various types of income (Cawley et al. 2010; Cawley and Price 2011). Most of the available research indicates that money windfalls have no impact on overweight and BMI measurements. However, we exploit a different source of variation, namely we rely on self-reported financial gains from "wins on football pools, national lottery, or any type of gambling". Furthermore, we examine the heterogenous effects by working times, gender, and employment, and we test the effect of a number of mechansims such as the number of hours worked.

Second, we add to the ongoing debate about income and wealth effects on health (Smith 1999). Some research employing evidence from the reunification of Germany suggests that the influence of income on self-reported health and health satisfaction is relatively minimal (Frijters et al. 2005). In contrast, evidence form lottery wins seem to reveal non trivial effects, namely a positive effect on mental health but no effects on physical health (Lindahl 2005).[5] Third, previous studies examinig the effect of lottery wins on health fail to document the impact of lagged effects of income windfalls (such as lottery wins), as well as potentially relevant heterogeneous effects such as differences in education and working times. In this paper we show that, while evidence of average income effects on overweight confirms previous findings, there is significant heterogeneity to consider, which calls for a reconsideration of previous findings.

[3] But such working time reduction is mainly observed among those who benefit from a large win alone.

[4] This is typically the case of blue collar workers who get most of their exercise from their employment duties (Costa-Font and Saenz de Miera, 2022).

[5] One possible explanation is that the effect of income on health care is influenced by reverse causality, which means that better health may in turn increase an individual's carreer prospects and their earned income (Costa-Font and Ljunge 2018).

Fourth, this paper adds litertaure on the effects of lottery wins more widely (Cesarini et al. 2016; Apouey and Clark 2015; Cheng et al. 2018; Gardner and Oswald 2007), and cast doubts on the external validity of a recent paper that suggests that lottery wins in Singapore exert health effects (Kim and Koh 2021). However, such literature examines effects on different health outcomes, and tend to ignore the effect on overweight. The only exception is a study examining the effect of lottery wins and inheritance wealth on the weight and diet of Australians (Au and Johnston 2015), yet it does not examine lagged lottery income effects. Similarly, other studies drawing on an alternative strategy that exploits the effect of bequest income document, consistently, no significant effects on health (Meer et al. 2003; Kim and Ruhm 2012). That said, unlike lottery wins, income shocks from inheritances can be anticipated, hence it is important to further examine the effect of lottery wins in a context like the UK where a large share of the population plays the lottery.

We present evidence that suggests that unearned income from lottery winnings influence individuals' overweight in a year following the lottery win. A £1,000 win reduces overweight by 2–3 percentual points (pp), and a larger effect (4-5pp) among low education individuals. The paper is organized as follows. The following section summarises the related literature on lottery wins, with a focus on evidence of income effects on overweight. Section three then presents the data and empirical strategy. Section four summarises the findings, and section five concludes.

2 Income effects on health and overweight

2.1 Income effects on physical and mental health

The availability of data containing individual records on lottery wins has paved the way for the proliferation of studies examining income effects on several health and health related behaviours. Lindahl (2005) documents evidence that a lottery win reduces mortality, he finds that a 10% increase in unearned income reduces mortality by 0.01–0.02 standard deviations. However, Apouey and Clark (2015) find no evidence of a lottery win effect on self-reported health, although they report evidence of an effect on mental health. Consistently, Gardner and Oswald (2007) drawing on data from the British Household Panel Survey, find that large lottery wins (£1000 and £120,000) do exert contemporanous and lagged improvements on psychological health. Indeed, two years after a lottery win, the average measured improvement in mental wellbeing is 1.4 GHQ points. Finally, a more recent study examining lottery wins in Singapore suggest evidence of effects on physical health (Kim and Koh 2021). Hence, it appears that the question of income effects in the literature is far from settled. One potential explanation for the heterogeneity across the different study estimates lies in the consideration of long term effects, as health investments do not have immediate effects on physical health, though they might have short term effects on mental health.

Other sources of evidence on income effects come from unanticipated changes in taxation. Indeed, some studies show that tax rebates exert a large and positive impact on mental health, which is explained by a reduction in feelings of stress and worry (Lachowska 2017).

2.2 Income effects on overweight

The causal literature on income effects on overweight and obesity is limited to small number of contributions. Cawley et al. (2010) exploit evidence from a social security "notch" that gave rise to a variation in the income of otherwise identical individual's based on their year of birth. They do not find any evidence of a causal relationship between income and weight. Other studies have focused on examining the effect of lottery wins on child weight. Cesarini et al. (2016) found that although lottery wins do not exert major changes in child outcomes, they find that wealth reduced the probability of child obesity. Finally, Au and Johnston (2015) document evidence suggesting no contemporanous effect of lottery wins and inheritance wealth on obesity among men, yet an effect among women. However, long term effects are generally neglected, as well as the differential effects on working times and other potential behavioural reactions resulting form a windfall income.

Consistently, experimental studies do not find any long-term effect of financial incentives on adult weight. Cawley and Price (2011) find that worksite programs offering modest cash rewards for specific employee weight loss (e.g., \$30 per quarter for a 10% weight loss) were not successful in reducing adult weight. However, they document evidence that the effectiveness of incentives changes over time. Consistently, Finkelstein et al. (2012) documents evidence of modest weight loss at 3 months after a financial incentive, but no difference after 6 months.

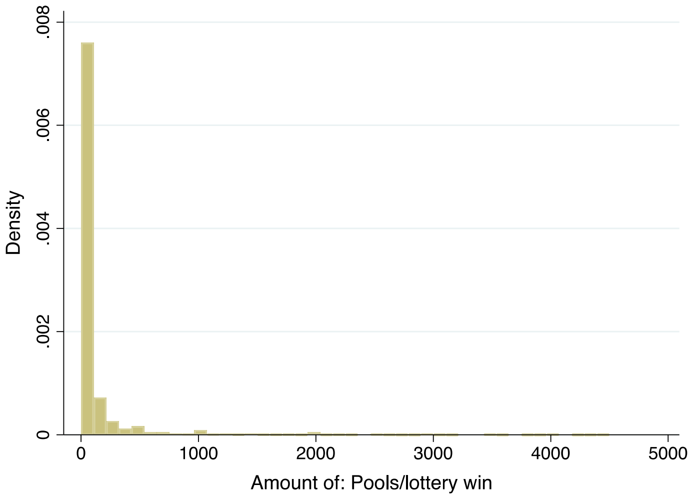
3 Data and empirical strategy

3.1 The data

This study draws on longitudinal data from five consecutive waves of the British Household Panel Survey (BHPS) collected between 2002 and 2007 where we can identify individual level weight and height records alongside windfall income resulting from lottery wins. BHPS follows a nationally representative sample of more than 5000 British households, containing over 10,000 adult individuals, conducted between September and Christmas of each year from 1991 to 2009. This dataset has been used by number of published studies to study overweight and obesity (Oswald and Powdthavee 2007; Blanchflower et al. 2009).

Respondents are interviewed in successive waves and households who move to a new residence are interviewed at their new location. If an individual splits off from the original household, all adult members of their new household are also interviewed. Children are interviewed once they turn 16 years. More importantly, the sample has remained broadly representative of the British population from the outset.

Our sample of interest includes all individuals who have reported a financial windfall income in the period, either lottery wins or, alternatively, a win on the soccer pools, in at *least one survey wave* alongside weight and height data. BMI and overweight are estimated following the definition of body mass index (BMI), and the latter is computed from the individually reported weight in kilos divided by the square of height in meters. Individuals with a BMI exceeding 25 are classified as overweight, and those



Note: Sample is restricted to individuals who reported at least one lottery win over the 16-year survey period, sample BHPS

Fig. 1 Density of lottery wins in the study sample

whose BMI exceeds 30 are classified as obese. Inevitably, the use of BMI restricts the number of waves we can use.

Lottery wins are estimated from actual questions in the BHPS survey as follows: (1) "Have you received any lump sum payments from wins on football pools, national lottery, or other form of gambling?"; (2) "About how much in total did you receive?". In Britain, the ratio of lottery players to those who play the football pools is approximately 50 to 1, hence winnings would overwhelmingly be represented by lottery wins (Cheng et al. 2018). Figure 1 reports the distribution of the lottery wins as we observe them in the sample. As expected, most individuals report no lottery win, and the distribution of wins spreads across different amounts. About 14,953 individuals people got some win, 1639 got a £250 win and 873 got at least £500 or more during the period of analysis.

To allow for lagged effects, the height and weight data is available for the period from 2002 to 2007. Hence, we observe whether an individual has won the lottery within a 5-year period but we use a longer time frame of lottery wins to capture changes in weight and height from 2 years before the win to 2 years after. As it has been established in studies that examine evidence from lottery wins, the lottery prize variable is skewed (Cesarini et al. 2016). One way to check whether the inference based on analytical standard errors can be affected by a finite sample bias we estimate a randomly permuted lottery wins obtained from resampling procedure without replacement.

Although winning the lottery is a random event, both participation and the amount spent on lottery ticket purchases are not. Consistently with Cheng et al (2018) we estimate the association of personal characteristics and the likelihood of an individual playing the lottery, and all except household income and employment status insignificant (see Table A0 in the appendix). The list of controls included is limited to avoid the problem of bad controls biasing our estimates. However, once such effects are accounted for, we expect both the extensive and intensive margin of wins to be orthogonal to any other individual-level characteristics. One potential concern could be that more frequent players also win the lottery more frequently. Similarly, it can be argued that restricting the sample to those who report a windfall win at some point over the period does not ensure that these individuals only were gambling during a shorter period. Alternative estimation strategies are reported in Tables A4 and A5 in the appendix. We also include individual-level fixed effects that allow us to control for possible unobservable individual characteristics influencing individuals propensity to play the lottery.

Table 1 Descriptive statistics of the main dependent and independent variables

	Sample of analysis			BHPS		
	Mean	SD	# Observations	Mean	SD	# Observations
Dependent and treatment variables						
BMI (Body Mass Index)	26.78	4.87	7759	26.35	4.94	22,646
Overweight (BMI > 25)	0.609	0.48	7759	0.567	0.49	22,646
Obesity (BMI > 30)	0.214	0.41	7759	0.191	0.39	22,646
Lottery win (£)	**50.32**	**436.41**	**7759**	**26.18**	**1353**	**22,646**
Controls variables						
Female (= 1)	0.453	0.49	7759	0.518	0.59	22,646
Age (years)	48	17.28	7759	46.46	18.34	22,646
Home ownership (= 1)	0.79	0.4	7759	0.77	0.42	22,507
Married (= 1)	0.7	0.46	7759	0.65	0.48	22,646
Secondary education (= 1)	0.55	0.49	7759	0.56	0.5	22,646
Tertiary education (= 1)	0.45	0.49	7759	0.43	0.5	22,646
Unemployed (= 1)	0.034	0.18	7759	0.042	0.2	22,646
Net household income (£)	29,942	20,460	7759	28,825	20,314	22,646
Net per capita income (£)	12,100	8566	7759	11,092	8072	22,646

Note: Means, standard deviation (SD) and number of observations of the main dependent variables' lottery win and control variables

Our primary analysis of lottery wins is initually at the year of the survey instead of distinguishing between winners and non-winners to minimize the presence of unobserved heterogeneity influencing both the decision to participate in the lottery and the propensity to engage in healthy behaviours. Our identification strategy exploits evidence form differences in lottery wins conditional on individuals fixed effects, time effects and other individual characteristics. The variation of lottery wins is regarded as exogenous, after controlling for a series of relevant covariates and individual fixed effects. Indeed, although personal traits and proxies of social capital influence individuals' propensity to receive windfall income (including lottery wins), early life experiences can play a role too. However, it seems reasonsable to expect that the inclusion of individual fixed effects does absorb the effects of such time invariant traits. Furthermore, we have run a series of robustness checks, and considered individual characteristics potentially explaining the propensity of a lottery win. Table 1 displays the mean, standard deviation, and number of observations of our main dependent variables, namely overweight and body mass index (BMI). [6] We report the mean lottery wins and a series of control variables as demographic characteristics, housing tenure, labour earnings, and employment. Furthermore, Table 1 reports the mean and standard deviation of the variables in the sample of analysis and the sample of the British Household Panel. We find no differences in the means of the main dependent variables, and in bold we highlight the main treatment variable of interest.

Table 1 reveals that average BMI does not show any significant differences between our sample of lottery players and the general BHPS data. The same is true when we compare the average overweight across samples, and overall, evidence indicates that about 57% of the UK population is overweight and 19–21% is obese during the sample years. 54% of the respondents are female, 73% own a property and 64% are married. The average income is £26,840 and the average lottery win during the period is of £216. Similarly, we find no differences in the means of the characteristics in the sample except for gender and unemployment status (smaller share of women and unemployed in our sample). As expected, our sample reveals a larger share of lottery wins compared to the BHPS sample and a smaller variation.

3.2 Empirical strategy

Our empirical strategy examines the impact of income windfalls on an individual's overweight and BMI controlling for individual fixed effects, time specific variation and potential covariates that can independently drive changes in overweight. Consistent with other previous research we restrict our sample to lottery players (Lindahl 2005). We focus on the effect of any lottery wins as well as the amount of the associated wins, alongside the effect of large lottery wins, namely wins exceeding the value of £500. Finally, we examine both contemporaneous effects as well as lagged effects.

[6] The data contains records on individual reported weight (kilograms) and heights (in cm), and hence body mass index (BMI) can be computed as the weight divided by the height in meters squared. An individual is recorded as overweight if BMI exceeds 25, and obese if its BMI exceeds 30

We expect an heterogeneous effect of a lottery win only for individuals who are and are not overweight at baseline. Health investments might be more intense for people who have a healthy weight at baseline. Our focus is on individuals who participate in the lottery, which are affected by lottery wins in different ways. Given that health investments encompass monetary investments, a lottery win might provide the means for individuals to undertake such health investments, including not working overtime, or purchasing nutritious foods. On the other hand, income shocks may alter individuals' preferences, shifting their consumption bundle away from (or into) healthy investments, and toward luxuries that may have an impact on overweight.

Let us denote L_{it} as the lottery wins of a household i at time t and let y_{it} denote the overweight of an individual measured in both the extensive margin and the intensive margin as BMI. When we examine lagged effects, we consider y_{it+T} where T takes the value of 0, 1, 2, 3 etc. Hence, a lottery win might take some time to change an individual's overweight. Our main equation of interest is:

$$y_{it+T} = L_{it}\theta_T + X_{it}\delta_T + \delta_i + \mu_t + \varepsilon_{it+T} \tag{1}$$

where $i = 1, \ldots, N$ and $t = 1, \ldots, T$, X_{it} refers to a set of controls variables (age, education attainment, household size, household income, citizenship) influencing BMI and overweight at time t, δ_T measures the coefficients of such controls, θ_T refers to the effect of a lottery win whether contemporaneous ($T = 0$), or with a lag and ε_{it+T} refer to the error term. We include in our specification time (μ_t) and individual fixed effects δ_i which control for individual specific heterogeneity, and capture the effect of unobservables influencing potential self-reporting bias in individuals' weight and height. If the effect of a lottery win is random, and hence uncorrelated with the error term, one would expect the estimates of θ_T to be unbiased. Our estimates are identified if the variation in the amount of real lottery winnings, L_{it}, among lottery winners in the year of winning, are uncorrelated with both the unobserved components of the regression equation, namely δ_i and ε_{it+T}. Given that some control variables can be regarded as potentially endogenous (e.g., employment status), we have tested the magnitude of the effect with and without them.[7]

Although lottery wins are typically random, it is possible to argue that large winnings may be the result of unobserved lottery spend, which is known as the "lottery-ticket (LT) bias" (Kim and Oswald 2020). However, if variation in lottery ticket spending is inertial, it will be absorbed by the inclusion of individual fixed effects. Furthermore, we have included the order of the win in the panel as a way of distinguishing 'one-off' from persistent lottery wins. Consistently with Cheng et al (2018) we have examined the association between personal characteristics and playing the lottery, and all except being unemployed are insignificant. Although individuals can affect the likelihood of winning the lottery, and the size of a lottery prize by their playing behaviour, in our sample we cannot distinguish between regular and occasional players.[8]

[7] Another option is to fix the covariables at the first period of analysis yet estimates do not exhibit significant differences and impose unnecessary assumption on our data.

[8] Individuals could face episodes of frequent playing with episodes of infrequent playing. This becomes problematic if certain life events (e.g., unemployment) make individuals more likely to play and, at the

Finally, it's worth considering that gambling or playing the lottery is not exogenous, and that while a win may be considered "random", there is a correlation between gambling more frequently and the probability of winning. Our specification assumes that individual fixed effects are likely to absorb time invariant traits that influence gambling behaviour, and other time-varying events that influence gambling behaviour (e.g., if someone loses their job unexpectedly, they may suddenly buy a lottery ticket), we control for, including unemployment status. This is important as unemployment can directly impact lifestyle behaviours and could therefore drive any association between lottery wins and BMI.

4 Results

We begin by examining how a £1000 lottery win impact on overweight and BMI following Eq. 1. Table 2 displays different estimates of a lottery win on BMI. Estimates reveal that a £1000 lottery win has no statistically significant effect on BMI. This is true regardless of the functional form specification or the inclusion of lags (see columns 1–6), and it is consistent with previous studies. However, when we evaluate the effect of a binary treatment variable, indicating whether a lottery win occurred in the previous 12 months, our regression estimates show that the occurrence of any lottery win increases BMI by 0.246 units in the year in which the lottery win occurs. However, estimates in column 4 suggest that large lottery wins in the previous year (> £500) result in a 0.414 units reduction in BMI. These results indicate that there is a small and nonlinear effect of a lottery win in the previous month on BMI.

Table 3 shows the impact of lottery winnings on the probability of overweight. Our estimates reveal that a previous (12-month) lottery win reduces individual overweight. More specifically, colums 1-3 indicate that whilst a contemporaneous a £1000 lottery win does not influence the probability of an individuals overweight, a £1000 lottery win in the previous year does result in a 2.3 percentual point (pp) reduction in the probability of overweight. However, when we add additional time lags, and consider two years examine the effect, we find a non-linear effect. That is, whilst a £1000 win in the previous year reduces overweiht in 3pp, after an additional year part of that weight is recovered. Furthermore, our regression estimates with dummy variables (column 5) show some imprecise evidence that the mere occurrence of a lottery win can increases individual's overweight, implying that the size of the income shock is decisive for the eventual overweight outcome Whilst, a small win can increase overweight, larger wins give rise to opposite effects. Finally, Table A1 in the appendix presents the same evidence and results as previously suggested that extreme overweight is systematically unaffected by income shocks such as lottery wins.

Table A6 investigates the impact of various lottery win amounts, namely £100, £250, and £1000. Consistent with previous findings, we find no significant effect on BMI or overweight, and we only find evidence of a significant reduction in BMI after a lottery win exceeds £1000 in the previous year. Finally, its worth mentioning that,

Footnote 8 continued
same time, their body weight adjusts to such new routines. However, we cannot identify 'regular players' in terms of frequency and size of the bets from the rest.

Table 2 Estimates on the impact of lottery wins on Body Mass Index (BMI) and standard errors in brackets

	(1)	(2)	(3)	(4)	(5)
Lottery win last 12 months in 1000£	0.494	0.15	0.548	0.613	
	(0.48)	(0.14)	(0.51)	(0.652)	
(Lottery win last 12 months in 1000£)^2		-9.31×10^{-5}			
		(8.92×10^{-5})			
1 Year—Lag (Lottery win last 12 months in 1000£)			−0.103	−0.0845	
			(0.200)	(0.22)	
1 Year—Lag (Lottery win last 12 months in 1000£)^2					
2 Year—Lag (Lottery win last 12 months in 1000£)				0.221	
				(0.637)	
2 Year—Lag (Lottery win last 12 months in 1000£)^2					
Any lottery win last 12 months (dummy)					0.246**
					(0.119)
Any lottery win over £500 last 12 months (dummy)					0.0255
					(0.355)
1 Year-Lag (Any lottery win last 12 months—dummy)					0.0387
					(0.0984)
1 Year-Lag (Any lottery win over £500 last 12 months—dummy)					−0.414*
					(0.235)
2 Year-Lag (Any lottery win last 12 months—dummy)					0.166
					(0.111)

Table 2 (continued)

	(1)	(2)	(3)	(4)	(5)
2 Year-Lag (Any lottery win over £500 last 12 months—dummy)					0.0144
					(0.267)
Time effects	x	x	x	x	x
Individual fixed effects	x	x	x	x	x
R-squared	0.046	0.046	0.046	0.040	0.043
Number of individuals	5001	5001	4886	4730	4730

Note: Robust standard errors in brackets. ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$. Sample is restricted to individuals who reported at least one lottery win over the 16-year survey period. All regressions include controls for age, age squared, log household income, binary variables on whether the person is married, and whether they are a homeowner, 7 dummy variables for educational achievement (following the ISCED categories: primary, lower secondary, upper secondary, post-secondary/non-tertiary, first degree tertiary, second degree tertiary; no formal education being the reference category), 9 dummy variables for employment status (in paid employment, unemployed, retired, maternity leave, family care, full-time student, long-term sick/disabled, government training scheme; self-employed being the reference category), as well as time effects

Table 3 Estimates of the impact of £1000 lottery wins and any lottery win on *overweight (standard errors in brackets)*

	(1)	(2)	(3)	(4)	(5)
Lottery win last 12 months in £1000	− 0.047	0.260	− 0.389	0.26	
	(0.20)	(0.241)	(0.24)	(0.166)	
(Lottery win last 12 months in £1000)^2		-2.71×10^{-5}			
		(2.35×10^{-5})			
1 Year-Lag (Lottery win last 12 months in 1000£)			− 0.0235**	− 0.0304***	
			(0.0975)	(0.0061)	
1 Year-Lag (Lottery win last 12 months in 1000£)^2				0.0576***	
				(0.002)	
2 Year-Lag (Lottery win last 12 months in 1000£)					
2 Year-Lag (Lottery win last 12 months in 1000£)^2					
Any lottery win last 12 months (dummy)					0.0275*
					(0.015)
Any lottery win over £500 last 12 months (dummy)					− 0.0183
					(0.049)
1 Year-Lag (Any lottery win last 12 months—dummy)					− 0.0126
					(0.0120)
1 Year-Lag (Any lottery win over £500 last 12 months—dummy)					− 0.0518
					(0.0443)
2 Year-Lag (Any lottery win last 12 months—dummy)					0.0225
					(0.014)

Table 3 (continued)

	(1)	(2)	(3)	(4)	(5)
2 Year-Lag (Any lottery win over £500 last 12 months—dummy)					0.0761
					(0.0534)
Controls	x	x	x	x	x
Time effect	x	x	x	x	x
Individual fixed effects	x	x	x	x	x
Observations	7759	7759	7550	7333	7333
R-squared	0.019	0.019	0.021	0.025	0.022
Number of individuals	5001	5001	4886	4730	4730

Note: Robust standard errors in brackets. ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$. Sample is restricted to individuals who reported at least one lottery win over the 16-year survey period. All regressions include controls for age, age squared, log household income, binary variables on whether the person is married, and whether they are a homeowner, 7 dummy variables for educational achievement (following the ISCED categories: primary, lower secondary, upper secondary, post-secondary/non-tertiary, first degree tertiary, second degree tertiary; no formal education being the reference category), 9 dummy variables for employment status (in paid employment, unemployed, retired, maternity leave, family care, full-time student, long-term sick/disabled, government training scheme; self-employed being the reference category), as well as a time effect the effects on overweight are imprecisely estimated when large gains are considered alone. Hence, can conclude that the effects of lottery wins take a while to exert an influence health behavior so to influence peoples overweight, and only reveal an effect a year after the win.

5 Heterogeneity

5.1 Effects across the BMI distribution

Given that average estimates may conceal significant heterogeneous effects, and in order to gain additional insight into potential effects across individuals, we proceed to use a quantile regression analysis to evaluate the effect of a lottery win at various points along the BMI distribution. However, given that we cannot control for fixed effects, the estimates are likely to be biased and estimates are presented in the appendix. Table A8 in the appendix reports the effect of any lottery win over £500. Estimates suggest that the impact of a lottery win is most pronounced when evaluated at both the four and ninth deciles of the BMI distribution.[9] Table A9 documents a statistically significant and positive effect of lottery wins on BMI for those in the lowest BMI decile if we consider a lottery win in the last 12 months. Finally, in Table A10 we evaluate the effect at the highest conditional distribution of BMI for wins in the previous 36 months.[10]

5.2 Gender effects

Table 4 displays the estimates of the heterogeneous treatment effects based on respondent gender. Consistently with previous results, the interaction terms between a contemporaneous lottery win and female gender are not statistically significant. However, we find evidence of a quadratic relationship between the amount of a lottery win, a year after the win, and both woman's BMI and their likelihood of overweight. We find that a year lagged £1000 lottery reduces onveweight by 1pp. However, such effects become non-linear when we consider quadratic effects of lagged wins in column 8, suggesting that whilst small lottery wins tend to increase women's likelihood of becoming overweight in the following year, large wins tend to lower the risk of overweight, following an inverted U-shape. This is supported by an analysis of the subsample of women presented in appendix tables A2 and A3. Indeed, small lottery wins (under £500) result in a contemporaneous increase in overweight, whereas large lottery wins (over £500) result in a contemporaneous decrease in obesity risk. This is demonstrated in column 7 of Table A3, where the likelihood of being overweight is regressed on binary variables related to small vs. large lottery wins. Overall, the heterogeneity analysis suggests evidence of non-linear effects among women. Small

[9] Furthermore, the effect size in the highest BMI decile is more than twice as large as in the first-fourth decile.

[10] When we consider the cumulative effects, we find that an additional £10,000 in windfall income over three years (£3,333 per year) raises the conditional BMI by 1.38 percentual points (pp) when evaluated at the highest quantile, namely a 5% increase in average BMI.

Table 4 Heterogeneous gender treatment effects

Variables	BMI				Overweight			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lottery win (1000£)	0.592	0.217	0.604	0. 255	− 0.043	0.389	− 0.039	0.408
	(0.480)	(0.158)	(0.470)	(0.156)	(0.267)	(0.248)	(0.263)	(0.24)
Win(1000£) × Female	− 0.519	− 0. 284	− 0.976	− 0.418	− 0.019	-7.14×10^{-4}	− 0.0235	− 0.862
	(0.127)	(0. 462)	(0.365)	(1.34)	(− .3.55)	(0.856)	(0.744)	(0. 139)
Lottery win (1000£)^2		-1.29×10^{-4}		-1.54×10^{-4}		-3.51×10^{-5}		-3.72×10^{-5}
		(9.70×10^{-5})		(9.52×10^{-4})		(2.14×10^{-5})		(2.34×10^{-5})
Lottery win (1000£)^2 × Female		0.000231		7.47×10^{-4}		7.11×10^{-5}		2.56×10^{-5}
		(0.0045)		(0.00064)		(8.39×10^{-5})		(7.46×10^{-5})
Lag (lottery win (1000£))			0.0420	0.0128			− 0.0167	− 0.445
			(0.0496)	(0.0219)			(0.174)	(0.359)
Lag (lottery win (1000£)) × Female			− 0.0794	− 0.0336			− 0.0107*	0.0671*
			(0.0564)	(0.0271)			(0.0019)	(0.0384)
Lag (lottery win (1000£)^2)				-4.57×10^{-8}				2.34×10^{-5}
				(1.28×10^{-7})				(2.00×10^{-5})
Lag (lottery win (1000£)^2) × Female				1.17×10^{-4}				-4.40×10^{-5}**
				(1.41×10^{-4})				(2.07×10^{-5})
Individual-level controls	x	x	x	x	x	x	x	x

Table 4 (continued)

Variables	BMI				Overweight			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Individual-level fixed effects	x	x	x	x	x	x	x	x
Time effect	x	x	x	x	x	x	x	x
Observations	7759	7759	7550	7550	7759	7759	7550	7550
R-squared	0.046	0.046	0.047	0.047	0.019	0.020	0.021	0.023

Note: Robust standard errors in brackets. ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$. Sample is restricted to individuals who reported at least one lottery win over the 16-year survey period. All regressions include controls for age, age squared, log household income, binary variables on whether the person is married, and homeownership, 9 dummy variables for employment status (in paid employment, unemployed, retired, maternity leave, family care, full-time student, long-term sick/disabled, government training scheme; self-employed being the reference category), as well as a linear time effect lottery wins increase the probability of overweight among women, whereas larger wins exert the opposite effect.

5.3 Heterogeneous effects on working times and education

Finally, Tables 5 and 6 report additional evidence of heterogeneous income effects based on individuals working hours (long working hours) and their education attainment (low education). More specifically, Table 5 depicts the effect of a lottery win on BMI and on the probability of overweight. Consistently with the idea that individuals that work long hours tend to have lower flexibility to adjust their lifestyles to stay in a healthy weight (time poor), we find for such a group an increase in both BMI and overweight after a contemporanous £1000 lottery win. In contrast, we estimate a slight reduction on BMI after a one year lagged £1000 lottery win. That is, we document that lottery wins result in small increases in overweight among people who work long hours (more than 35 h per week).

Finally, Table 6 displays evidence of significant heterogeneity in the impact of a lottery win based on an individual's educational achievement. More specifically, we find that a lottery win reduces individual's overweight among people with low educational attainment (primary education or less). Although the effect is non-linear when BMI is considered, the net effect is negative and significant. Accordingly, a £1000 income windfall among low education individuals reduces overweight by 4.5–5 percentual points (pp). Such effect corresponds to a 7–8% reduction in overweight compared to average overweight consistently with previous studies, suggesting evidence of inequalities in overweight which are driven by education primarily (Costa-Font et al. 2014, Costa-Font and Gil 2008).

Finally, Table A7 in the appendix, reports evidence of alternative mechanisms, such as the effect on smoking, self-reported health, and exercise. However, we find no effect other than a 2 pp increase in the probability of exercising after a £1000 lottery win which is consistent with a lagged reduction in overweight following such lottery win.

6 Conclusion

Drawing on unique longitudinal data from lottery wins in the United Kingdom, we investigate the effect of unearned income on overweight. We find that although any income windfall may lead to a contemporaneus increase in overweight, larger wins can reduce the probability of overweight within a year of such income windfalls. However, the size and timing of the lottery wins matters. Consistently with prior evidence, our findings indicate no evidence of a contemporanous £1000 lottery win on overweight. However, we find a reduction in overweight 12 months after a £1000 lottery win. According to our estimates, a £1,000 win reduces overweight by 2–3% percentual points (pp). These effects are not negligible and are economically significant, and suggest a 3% reduction in average overweight.

Table 5 Heterogeneous treatment effects for individuals with long working hours (more than 35 h per week) and standard error are presented in brackets

Variables	(1) BMI	(2)	(3)	(4) Overweight	(5)	(6)
Lottery win (1000£)	0.749	0.327	0.405	− 0.0526	− 0.0460	− 0.0048
	(0.732)	(0.362)	(0.507)	(0.0158)	(0.0762)	(0.0159)
Win (1000£) × long working hours	0.404	− 0.632	0.282*	0.0639***	0.0413	0.0758**
	(0.114)	(0.434)	(0.162)	(0.240)	(0.0783)	(0.0319)
Lottery win^2 (1000£)		-3.13×10^{-4}			5.01×10^{-5}	
		(3.73×10^{-4})			(7.76×10^{-5})	
Lottery win (1000£)^2 × long working hours		1.47×10^{-4}			2.11×10^{-5}	
		(4.18×10^{-4})			(7.85×10^{-5})	
1-Year Lag (1000£)win			− 0.15**			− 0.0179
			(0.6.59)			(0.0171)
1-Year Lag (1000£).win × long working hours			0.450**			0.0334
			(0.213)			(0.041)
Individual-level controls	x	x	x	x	x	x
Individual-level fixed effects	x	x	x	x	x	x
Time effect	x	x	x	x	x	x
Observations	3034	2954	2954	3034	2954	2954
R-squared	0.050	0.050	0.049	0.027	0.029	0.025

Note: Robust standard errors in parentheses. ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$. Sample is restricted to individuals who reported at least one lottery win over the 16-year survey period. All regressions include controls for age, age squared, log household income, binary variables on whether the person is married, and whether they are a homeowner, 7 dummy variables for educational achievement (following the ISCED categories: primary, lower secondary, upper secondary, post-secondary/non-tertiary, first degree tertiary, second degree tertiary; no formal education being the reference category), 9 dummy variables for employment status (in paid employment, unemployed, retired, maternity leave, family care, full-time student, long-term sick/disabled, government training scheme; self-employed being the reference category), as well as a linear time effect

Table 6 Heterogeneous treatment effects for individuals with low educational attainment (primary schooling or lower)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	BMI			Overweight		
Lottery win (1000£)	0.494 (4.3 × 10^{-4})	0.155 (0.00014)	0.548 (5.1 × 10^{-4})	− 0.047 (0.220)	0.0260 (0.0241)	− 0.03.89 (0.24)
Win (1000£) × Low education	3.83 (0.0410)	− 5.50*** (1.17)	− 1.65 (36.3)	− 0.046** (0.019)	− 0.020** (0.002)	− 0.083*** (0.0019)
Lottery win $(1000£)^2$		− 9.31 × 10^{-5} (8.92 × 10^{-5})			− 2.71 × 10^{-5} (2.35 × 10^{-5})	
Lottery win $(1000£)^2$ × Low education		2.7*** (0. 1)			− 0.197 (0.171)	
1-Year Lag win (1000£)			− 0. 103 (0.2.00)			− 0.0235** (0.00976)
1-Year Lag (1000£) × Low education			− 1.41 (2.61)			0.000392 (0.000379)
Individual-level controls	x	x	x	x	x	x
Individual-level fixed effects	x	x	x	x	x	x
Time effect	x	x	x	x	x	x
Observations	5001	4866	4866	5001	4866	4866
R-squared	0.050	0.050	0.049	0.027	0.029	0.025

Note: Robust standard errors in parentheses. ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$. Sample is restricted to individuals who reported at least one lottery win over the 16-year survey period. All regressions include controls for age, age squared, log household income, binary variables on whether the person is married, and homeownership, 9 dummy variables for employment status (in paid employment, unemployed, retired, maternity leave, family care, full-time student, long-term sick/disabled, government training scheme; self-employed being the reference category), as well as a time effect

We further document heterogeneous effects of lottery wins based on working times and education attainment. While a lottery win gives rise to an increase in overweight among people who work long hours, the opposite is true among low education individuals. We estimate that a £1000 lottery win among low-education individuals reduces overweight by 4.5–5 pp, namely 7–8% reduction compared to average overweight. This evidence supports the notion that exogenous income shocks have a delayed effect in reducing overweight expecially among low education individuals, which are consistent with evidence of important income inequalities in overweight (Costa-Font et al. 2014). Furthermore, our estimates suggest that easing income contraints might not suffice to exert an influence on overweight among time poor individuals.

Overall, these estimates suggest that income effects can take some time to produce effect on overweight, but they suggest that there is potential for using monetary incentives targeting specific groups (low education individuals) who appear to respond differently to a windfall income change.

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