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Imperfect information on physical activity and caloric intake☆

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ABSTRACT

Using the National Health and Nutrition Examination Survey Data, I find that individuals who overestimate their activity level by one standard deviation consume 40–60 extra calories per day, or enough to gain five pounds per year. These extra calories are composed mainly of sugar and carbohydrate, and are concentrated among individuals in the 75th and 90th percentiles of caloric intake. The link between overeating and inaccurate estimation of physical activity is strongest among less educated individuals and individuals with high variance in their physical activity, suggesting that imperfect recall or information gaps explain at least part of the relationship of interest. These results imply the existence of a necessary condition for physical activity-based information treatments to be effective in changing health behaviors and obesity rates.

1. Introduction

The societal costs of obesity are well documented. Reuters reports that obesity costs $216 billion per year, a figure in excess of the costs attributable to smoking (Begley, 2012). Obesity leads to onset of chronic illness and increased medical care costs (Finkelstein et al., 2003; Flegal et al., 2010). Overweight and obesity may lead to lower earnings, lower productivity in the workplace (Cawley, 2004; Baum and Ruhm, 2009; Gregory and Ruhm, 2009) and less favorable outcomes in the marriage market (Oreffice and Quintana-Domeque, 2010; Chiappori et al., 2012). Economists and policy makers continue investigate the policy options to address obesity, focusing primarily on information and incentives.

Biologically, body weight is a function of net caloric consumption. If one assumes that individuals have complete and accurate information about their caloric intake and expenditure, body weight is an economic function of the relative costs (time and money) of caloric intake and expenditure. There is considerable debate about the causes of increased obesity rates, as they coincide with several other changes that have affected the relative costs of caloric intake and expenditure: an increase in the availability of convenient unhealthy food, changes in the economic environment and relative food prices, escalating portion sizes, decreased smoking, technological advances in sedentary entertainment, and shifts towards sedentary employment (Cutler et al., 2003; Powell, 2009; Chou et al., 2004; Courtemanche, 2009; Courtemanche et al., 2015b; Lakdawalla and Philipson, 2009; Lakdawalla et al., 2005; Sarma et al., 2014). Prior work has shown that education and personality traits impact health behaviors and obesity (Webbink et al., 2010; Cutler and Lleras-Muney, 2010; Conti and Hansman, 2013). More recent work has

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incorporated hyperbolic discounting, and a very present-focused "dual self" that makes choices inconsistent with expected present discounted value maximization (Courtemanche et al., 2015a; Scharff, 2009; Ikeda et al., 2010). Ruhm (2012) also points out that food producers have become more effective at targeting present-valuing impulses. Regardless of the determinants, if individuals have full information, are making rational decisions and becoming obese as a consequence, incentives will be necessary to change health behaviors.

Alternatively, if individuals are operating under incomplete or inaccurate information about their net caloric intake, then it is possible that improved information may affect individuals' health behaviors, increase the effectiveness of incentive programs, and improve welfare. From a policy perspective, information goods can be less costly to produce and implement than incentives for individuals. However, evidence on whether individuals respond to generalized health information on caloric content (or smoking) is mixed and somewhat idiosyncratic to setting (Downs et al., 2009; Elbel et al., 2009, 2013; Khwaja et al., 2009; Schwartz et al., 2012). Emerging work has shown that information interventions must be highly personalized to affect changes in health behaviors (Darden, 2015).

Previous mixed responses to information raises the question of whether individuals have accurate information or beliefs about their caloric expenditure (and consequently caloric needs). If individuals' beliefs are inaccurate, are these inaccuracies linked to eating behaviors? Most prior work that has assessed individuals' awareness has found that individuals are aware of what constitutes a 'reasonable daily caloric intake,' or are aware of their caloric needs within a 500 calorie range (Schwartz et al., 2012). While most of the previously cited field work has utilized general and somewhat coarse information, (e.g., labeling food as "healthy," caloric content posting, or invitations to eat smaller portions), small information imperfections in caloric needs or intake can lead to considerable changes in body weight over time if not corrected. For example, consuming 50 calories in excess of one's daily requirement can increase body weight by 5 pounds per year.[1]

This paper demonstrates that individuals perceive their physical activity levels with error, and this error is linked to caloric intake. I use nationally representative data, the 2003–2004 and 2005–2006 National Health and Nutrition Examination Survey (NHANES) data. The NHANES asks about self-reported physical activity, but also contains data on accelerometer-recorded physical activity over seven days. I use the reported and recorded data on physical activity to measure the extent to which individuals over (or under) estimate their physical activity. I show that individuals who overestimate their level of physical activity eat more calories, most of which come from sugar and carbohydrates. According to recent work by Riera-Chrichton and Tefft (2014), calories from carbohydrate lead to expected greater weight gain than fat or protein. Overestimating one's level of physical activity by one standard deviation leads to an increase of 40–60 calories per day, sufficient to cause or 4–6 pounds of weight gain per year.[2] These results show the existence of a necessary condition for information to change behaviors: individuals misunderstand their activity level (and therefore their caloric needs) and this misunderstanding is linked to food consumption decisions.

There are several empirical challenges that must be overcome to claim evidence of a behavioral mechanism, such as imperfect information, from misreporting in survey data. The NHANES is uniquely well suited as it contains data on reported and recorded weight, reported and recorded physical activity, and reported nutritional intake; which enables us to separate the effects of deliberate misreporting. This paper attributes the misreporting of physical activity to either intentional or unintentional misreporting, (acknowledging that some 'intentional' misreporting may happen subconsciously), claiming that that unintentional misreporting of physical activity is driven by imperfect information. Consistent with prior findings of favorable reporting bias in survey data, there is evidence of a systematic relationship between misreported body weight and misreported exercise.[3] Empirically, I mitigate the confounding effects of intentional misreporting by increasingly restricting the estimation samples to individuals who accurately report their body weight.[4] While I cannot positively eliminate all bias from intentional misreporting of exercise, I empirically demonstrate that reducing the bias from intentional misreporting strengthens the main result.

It is also possible that controlling for intentional misreporting as described above, that positive correlation in unintentional misreporting of physical activity and nutritional intake, rather than imperfect information, is responsible for the result of interest. This is unlikely, however, as validation studies of food diary and food recall in the NHANES and other surveys have found that individuals very seldom over-report their food intake (Horner et al., 2002; Archer et al., 2013). Additionally, the empirical results are not consistent with the hypothesis that our results are driven by positive correlation in misreporting of physical activity and caloric intake. If this was the case, one would expect a positive, statistically significant relationship between misreported exercise and

[1] The nutrition field (e.g., Mayo Clinic) holds that a 3500 calories roughly equates to 1 pound of fat, but acknowledges there is considerable heterogeneity among individuals.

[2] Clearly, this is only true so long as information imperfections persist and biological processes are relatively constant. Sooner or later, the bathroom scale or changing clothes sizes should revise individuals' expectations about caloric needs, but I cannot capture those dynamic aspects in cross-sectional data.

[3] However, this paper shows that this type of misreporting will bias these results downward.

[4] This paper acknowledges the substantial literature on joint misreporting on health variables and differential misreporting on the basis of income and education, including D'uva et al. (2008), Butler et al. (1987), Suziedelyte and Johar (2013), Johnston et al. (2009) and Ljungvall et al. (2015). However, the empirical analysis and sample restrictions are motivated by two notions. First, if individuals are accurately reporting their body weight, they are less likely to lie about their physical activity. Second, conditional on intention to accurately report physical activity, what else but imperfect information or mis-perception would cause an individual to mis-report? The results in this paper support both notions.