

Hyperbolic Discounting, the Sign Effect, and the Body Mass Index

Paper in journals: this is the first page of a paper published in *Journal of Health Economics*.

[*Journal of Health Economics*] 29, 268–284(2010)



Hyperbolic discounting, the sign effect, and the body mass index[☆]

Shinsuke Ikeda^{a,*}, Myong-Il Kang^{b,1}, Fumio Ohtake^{a,2}

^a The Institute of Social and Economic Research, Osaka University, 6-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan
^b Department of Business Administration, Korea University, 1-700 Ogawa-cho, Kodaira Tokyo 187-8560, Japan

ARTICLE INFO

Article history:
 Received 7 March 2009
 Received in revised form
 31 December 2009
 Accepted 13 January 2010
 Available online 25 January 2010

JEL classification:
 I10
 Z00

Keywords:
 Obesity
 Hyperbolic discounting
 Sign effect
 BMI
 Underweight

ABSTRACT

Analysis of a broad survey of Japanese adults confirms that time discounting relates to body weight, not only via impatience, but also via hyperbolic discounting, proxied by inclination toward procrastination, and the sign effect, where future negative payoffs are discounted at a lower rate than future positive payoffs. Body mass index is positively associated with survey responses indicative of impatience and hyperbolic discounting, and negatively associated with those indicative of the sign effect. A one-unit increase in the degree of procrastination is associated with a 2.81 percentage-point increase in the probability of being obese. Subjects exhibiting the sign effect show a 3.39 percentage-point lower probability of being obese and a 4.02 percentage-point higher probability of being underweight than those without the sign effect. These effects are substantial compared with the prevalence rates of the corresponding body mass status. Obesity and underweight thus result in part from the temporal decision biases.

© 2010 Elsevier B.V. All rights reserved.

1. Introduction

This paper examines how interpersonal differences in the body mass index (hereafter, BMI), defined as weight in kilograms divided

by height in meters squared (kg/m^2), are related to differences in time discounting, using data from a broad survey of Japanese adults. The focus is on the association of body mass not only with impatience, measured by the level of discount rates, but also with two behavioral properties of time discounting: hyperbolic discounting or the immediacy effect, where a person discounts his immediate future more intensely than his distant future, and the sign effect, where a person discounts positive payoffs more intensely than negative payoffs (e.g., Thaler, 1981; Ben Zion et al., 1989). To do so, we included questions in the survey that enabled us to measure the respondents' behavioral inclinations in time discounting.

We find that respondents' BMI is associated positively with the degree of impatience and negatively with the sign effect, where the significance levels are higher for the female sample than for the male sample. For example, an increase in impatience by one unit of the standard deviation is associated with an increase in BMI by 1.09% of the BMI mean, a 2.23 percentage-point increase in the probability of being obese, and a 0.83 percentage-point decrease in the probability of being underweight. Subjects exhibiting the sign effect show a 3.69 percentage-point lower probability of being obese and a 4.02 percentage-point higher probability of being underweight than those without the sign effect. These marginal effects are substantial compared with the prevalence rates, i.e., the unconditional probabilities, of the corresponding body mass status (e.g., 18.92% for obesity and 6.97% for underweight).

[☆] This is a revised version of Ikeda, Kang, and Ohtake (2009), which has been circulated under the title: "Fat debtors: Time discounting, its anomalies, and body mass index." Our special thanks go to I. Shimomura and T. Huhashi (Graduate School of Medicine, Osaka University) for helpful discussions from the viewpoint of medical science, and D.J. Flath, C.Y. Horicka, and two anonymous referees for helpful comments. We are also grateful to Y. Fukuta, R. Goto, D. Kawaguchi, K. Hirata, and participants at the 2008 meeting of the Association of Behavioral Economics and Finance, the International Workshop on the Economics of Obesity and Health 2009, and the faculty seminars of Hitotsubashi University, Osaka University, University of New South Wales, and Bond University for beneficial discussions. We acknowledge financial support from the COE and Global COE Programs of Osaka University. Ikeda and Ohtake acknowledge financial support from a Grant-in-Aid for Scientific Research (821330046 and 821214207, respectively) from the Japan Society for the Promotion of Science. A part of this study is the result of "Development of biomarker candidates for social behavior" carried out under the Strategic Research Program for Brain Sciences by the Ministry of Education, Culture, Sports, Science and Technology of Japan.

* Corresponding author. Tel.: +81 6 6879 8568.
 E-mail addresses: ikeda@iser.osaka-u.ac.jp (S. Ikeda), mkang@korea-u.ac.jp (M.-I. Kang), ohtake@iser.osaka-u.ac.jp (F. Ohtake).
¹ Tel.: +81 42 341 1331.
² Tel.: +81 6 6879 8572.

0167-6296/\$ – see front matter © 2010 Elsevier B.V. All rights reserved.
 doi:10.1016/j.jhealeco.2010.01.002

▲Reprinted from *Journal of Health Economics*, 29, Shinsuke Ikeda et al., Hyperbolic discounting, the sign effect, and the body mass index, 268–284, Copyright(2010), with permission from Elsevier.

The following is a comment on the published paper shown on the preceding page.

Time Discounting and Body Mass Index: Toward Economics of Obesity and Underweight

IKEDA Shinsuke and OHTAKE Fumio

(Institute of Social and Economic Research)

Introduction and hypotheses

In economic theory, when people make intertemporal decisions, their personal discount rates, which determine as their measure of impatience how much of their resources to consume for present gratification and how much to save for future gratification, are considered to play a key role. Because our body weight is a result of our past intertemporal choices on trade-offs between present gratification from eating and future one from health (and/or beauty), our body mass status (e.g., normal, obese, or underweight) will depend on our time discounting. Although the association between the personal discount rate and body mass status has been discussed in health economics, needed empirical research did not proceed so much.

In this paper, we, jointly with Myong-Il Kang, examined how interpersonal differences in the body mass index (hereafter, BMI), defined as weight in kilograms divided by height in meters squared (kg/m^2), are related to differences in time discounting, using data from a unique broad survey of Japanese adults. The novelty is to focus on the association of body mass not only with impatience, measured by the level of discount rates, but also with two behavioral aspects of time discounting: hyperbolic discounting, where a person discounts his or her immediate future by a higher rate than his or her distant future, and the sign effect, where future losses are discounted at a lower rate than future gains of the same amount. We hypothesize that body weight is associated positively with both impatience and hyperbolic discounting, and negatively with the sign effect.

Data

The research is based on the Japan Household Survey on Consumer Preferences and Satisfaction 2005 (hereinafter, JHS05), a nationwide household survey that the authors conducted in February 2005 as part of the Osaka University COE program, supported by the Ministry of Education, Culture, Sports, and Science and Technology.

Table 1. Summary statistics of the respondents' body mass

		Male	Female
BMI	Means	23.347	21.938
	S.D.	3.119	2.962
Prevalence rates	Underweight (BMI < 18.5)	0.042	0.095
	Obesity (BMI ≥ 25)	0.240	0.143
	Severe obesity (BMI ≥ 30)	0.029	0.015
Obs.		1369	1501

We randomly selected 6000 Japanese respondents older than 20 years of age and asked them to fill out questionnaires. Out of the 6000, 2987 responded, where male respondents occupied 47.0%, with the average age of the respondents being 49.08. We included in the survey various questions to elicit information about the respondents' attitudes toward time discounting and risk; their demographic, social, and economic attributes; and their health status including height and weight. From the self-reported data of height and weight, we calculate each respondent's BMI. As summarized in Table 1, the sample mean of BMI is 23.35 for males and 21.94 for females. According to a criterion provided in 2000 by the Japan Society for the Study of Obesity (Examination Committee 2002), the respondents are classified as: underweight if BMI < 18.5; normal if $18.5 \leq \text{BMI} < 25$; standard if BMI = 22; obese if BMI ≥ 25; and severely obese if BMI ≥ 30. In our data, underweight respondents occupy 4.2% in the male sample and 9.5% in the female sample; obese people occupy 24.0% and 14.3%; and severely obese respondents occupy 2.9% and 1.5%, respectively (see Table 1).

Results

Consistent with our hypotheses, we find that, the respondents' BMI is associated positively with both the degrees of impatience and hyperbolic discounting, and negatively with the sign effect, where the significance levels are higher for the female sample than for the male sample. Figures 1 through 3 summarize the results.

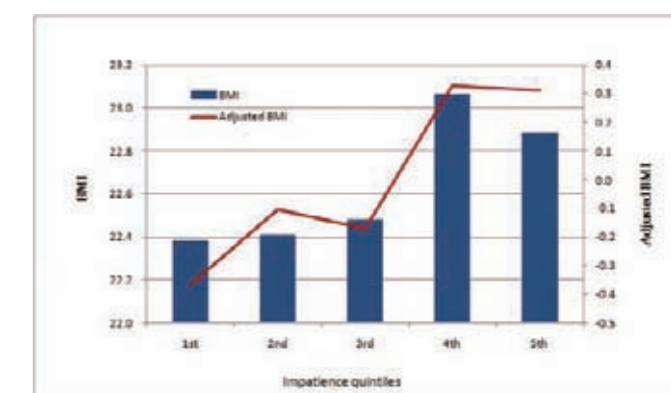


Fig. 1 BMI means in impatience quintiles. Note: "1st" represents the most patient quintile. "Adjusted BMI" represents BMI which is adjusted for other personal attributes such as sex, age, income, and the education level. The estimated results are from Ikeda et al. (2010).