

健康増進を目的とした 交通手段選択モデル

Transportation selection model
for health promotion

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背景 Background

- 男女とも年齢を重ねる毎に肥満率が上昇

The obesity rate rises with the age for both sexes

- 仕事があるため、運動をする時間がない

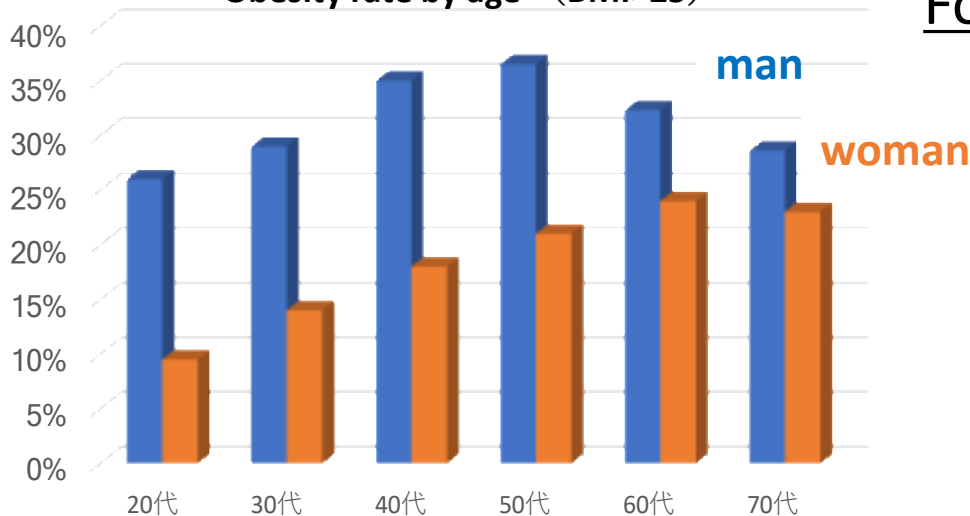
Workers do not have time to exercise because they have to work on weekdays

通勤でカロリーを消費すれば肥満率が下がるのでは？

The obesity rate decreases when workers consume calories during commuting

◆ 年齢別の肥満率 (BMI>25)

Obesity rate by age (BMI>25)



*厚生労働省「国民健康・栄養調査結果の概要」／平成28年

Focus on commuting in Yokohama

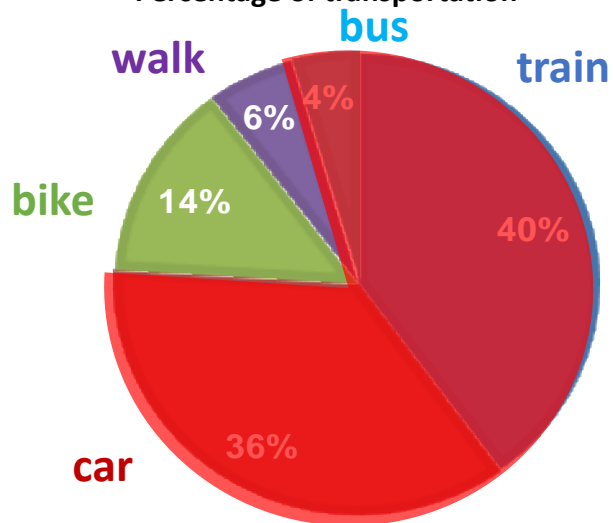


基礎集計 Basic aggregation

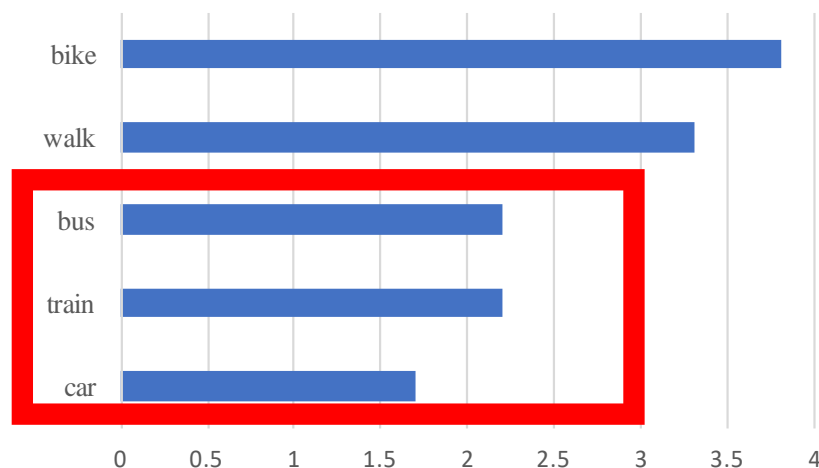
□ 通勤時では、消費カロリーが小さい交通手段が大半

When commuting, transportation with low calorie consumption is the majority

◆ 通勤時の交通手段の割合
Percentage of transportation



◆ 交通手段別 消費カロリー (kcal/min)
Calorie expenditure by transportation method (kcal / min)



*モビリティ・マネジメントの手引き

目的 purpose

消費カロリーが大きい交通手段で通勤させることで、BMIを下げさせたい
We would like to lower BMI by making commuting by means of transport which consume high calories

政策 Policy

- ◆ 「通勤時の消費カロリーに応じて、補助金を提供」する政策を提案
We propose a policy " Provide subsidies according to calories burned during commuting "
- ◆ 国土交通省では徒歩の一步が約0.07円の医療費抑制効果があると試算
The Ministry of Land, Infrastructure and Transport estimates that a step of walking has a medical cost reduction effect of about 0.07 yen
- ✓ カロリーについて貨幣換算すると... Converting calories to money

1 step=0.04 kcal
1 kcal=1.75 yen

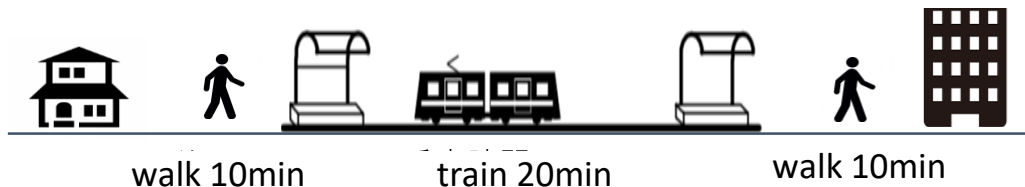


Focus on walking and bicycle

*まちづくりにおける健康増進効果を把握するための医療費抑制効果の見える化(原単位の試算)

Ex) Train commuting

walk(3.2kcal/min) × 20min=64 kcal=112 yen



Model

◆ MNL model

$$U_{in} = \beta_0 + \beta_1 cost_{in} + \beta_2 time_{in} (+\beta_3 egress\ access\ time_{in}) + \varepsilon_{in}$$

$cost_{in}$: cost

$kcal_{in}$: kilocalorie

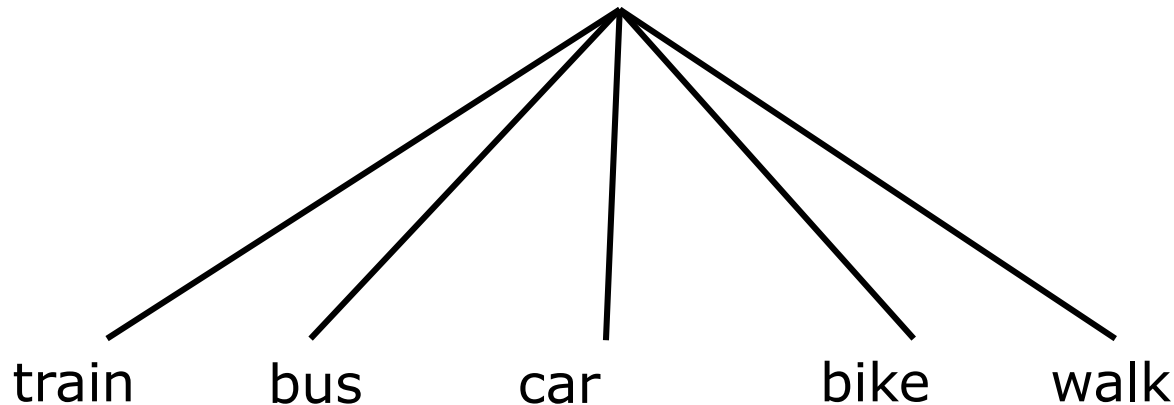
$\beta_0, \beta_1, \beta_2, \beta_3$: parameters

ε_{in} : error term

$time_{in}$: time

egress access time_{in}: egress access time



◆ Model structure



推定結果

Estimation result

Parameters		Estimate	t-value
Constant	bus	0.52	0.40
	train	2.24	3.47
	walk	1.97	2.08
	bike	2.67	4.90
time (hour)		-10.53	-6.83
cost (thousand yen)		-2.73	-1.98
access egress time (hour)		-7.93	-8.95
men dummy	train	3.46	3.96
	walk	3.61	4.11
	car	1.92	2.80
more than 20km dummy	car	1.07	1.63
women dummy	bus	2.96	2.40
number of samples		345	
adjusted likelihood ratio		0.654	
LLO		-492.418	
LLC		-492.428	
final LL & LLO		-158.475	
final LL & LLC		-420.738	

 : 5% significant
 : 10% significant

アウトプット Output

- ◆ モンテカルロシミュレーションによって最適な補助金
(総医療費抑制額/総補助金) を検討

Consider the optimum subsidy (medical cost reduction amount / total subsidy)
by Monte Carlo simulation

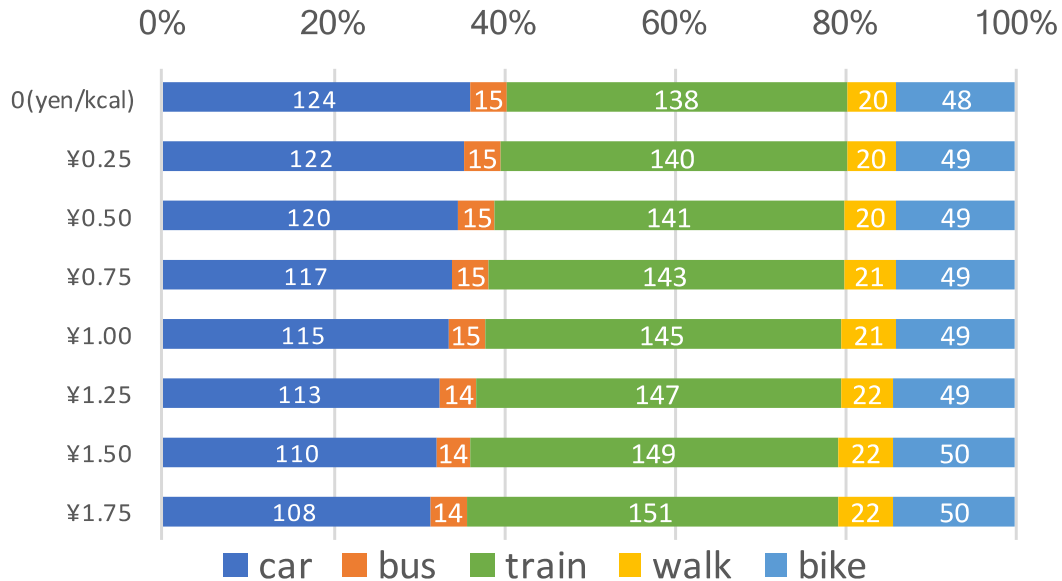


VS



昨日のシミュレーション結果

Yesterday's simulation result

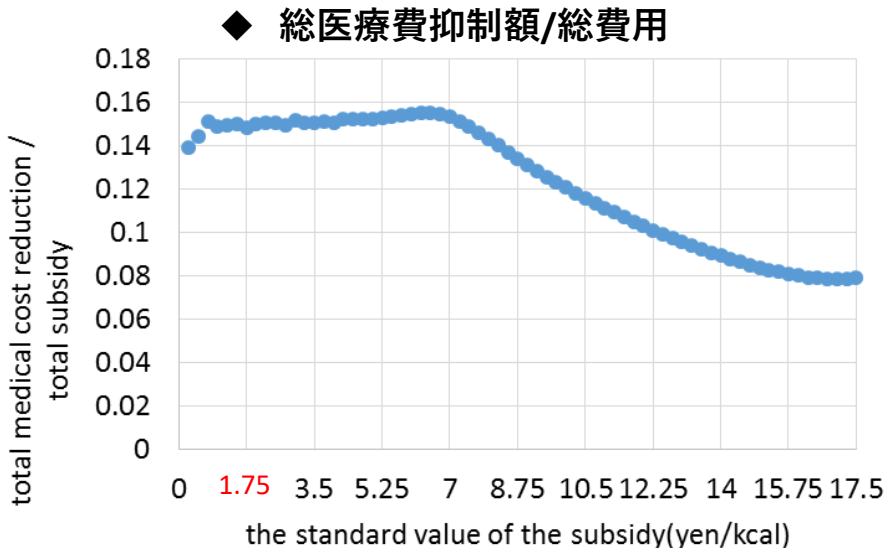


- ・ 自動車の割合が減少し， 鉄道の割合が増加
The proportion of automobiles decreases, the proportion of railway increases
- ・ 徒歩・自転率は微増
Walk and bicycle increase slightly
- ・ 総医療費抑制額/総補助金は0.15前後
total medical cost reduction / total subsidy is around 0.15

*総医療費抑制額=政策によって増加した消費カロリー×1.75 yen(医療費抑制額/1kcal)
total medical cost reduction =the consumption calorie increased by our policy × 1.75 yen(medical cost reduction/1kcal)

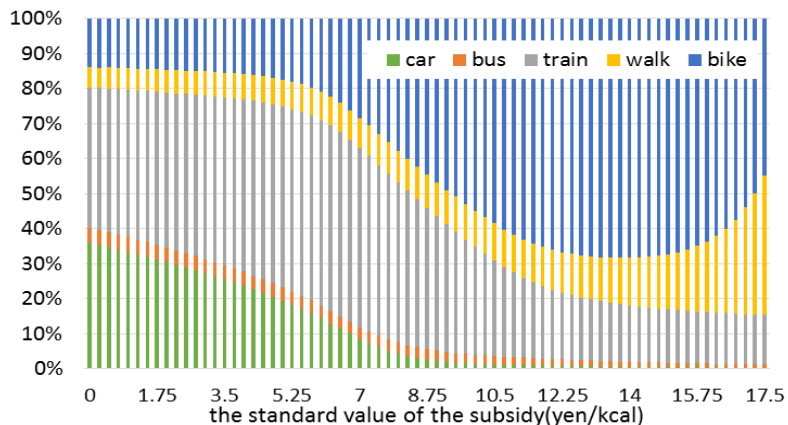
総医療費抑制額/総費用の変化

total medical cost reduction / total subsidy



- 7 yen/kcalから頭打ち
- 急激に低下

交通手段の移り変わり

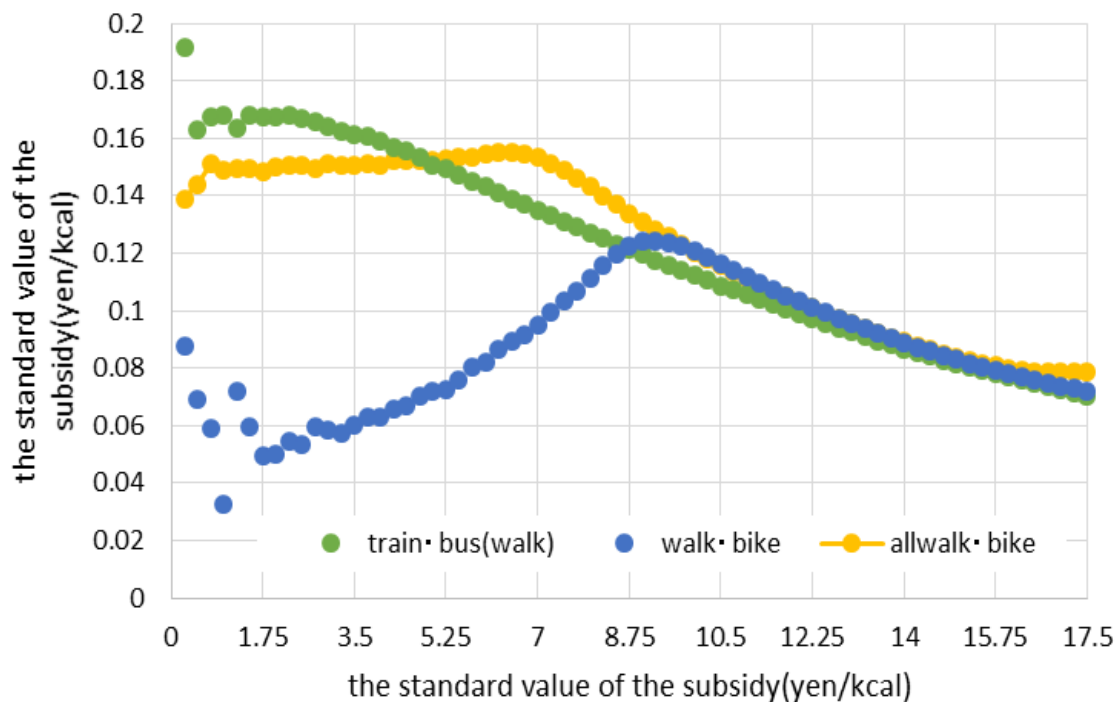


- 7 yen/kcalまでは自動車から鉄道への転換
Switch from car to train until 7 kcal
- 7 yen/kcalからは自転車・徒歩への転換
Switch to bike or walk for more than 7 kcal

7 yen/kcalを超えると自転車・徒歩が増え
総費用が多くなっていく

全ての徒歩に補助金を出すべきでない？

3種類の補助金 3kind of subsidy



徒歩・バイクのみに与えたときは大きな補助金が必要となる
When giving subsidies only to walks / bikes, a lot of money is needed

電車・バスのアクセス・イグレスに補助金を与える方が効果的
It is more effective to give subsidies to train / bus access · egress

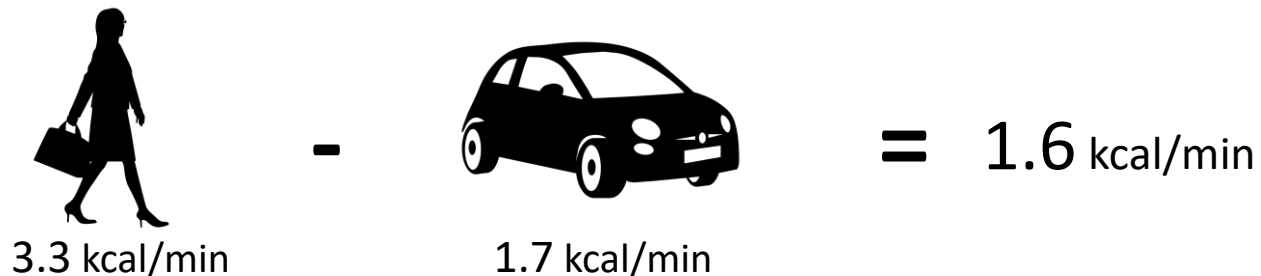
不健康税の導入 Introduction of unhealthy tax

◆ 自動車の利用者に対して課税

Taxation for car users

① 自動車と徒歩の消費カロリーの差分(1.6 kcal/min)を所要時間に応じて課税

Tax the difference (1.6 kcal/min) between the car's and walking calories burned as the required time.



The diagram illustrates the calculation of the difference in calories burned between walking and driving. On the left, a silhouette of a person walking with a briefcase is shown above the text '3.3 kcal/min'. In the center, a minus sign '-' is positioned between the walking figure and a silhouette of a car. Below the car is the text '1.7 kcal/min'. To the right of the car, an equals sign '=' is followed by the text '1.6 kcal/min'.

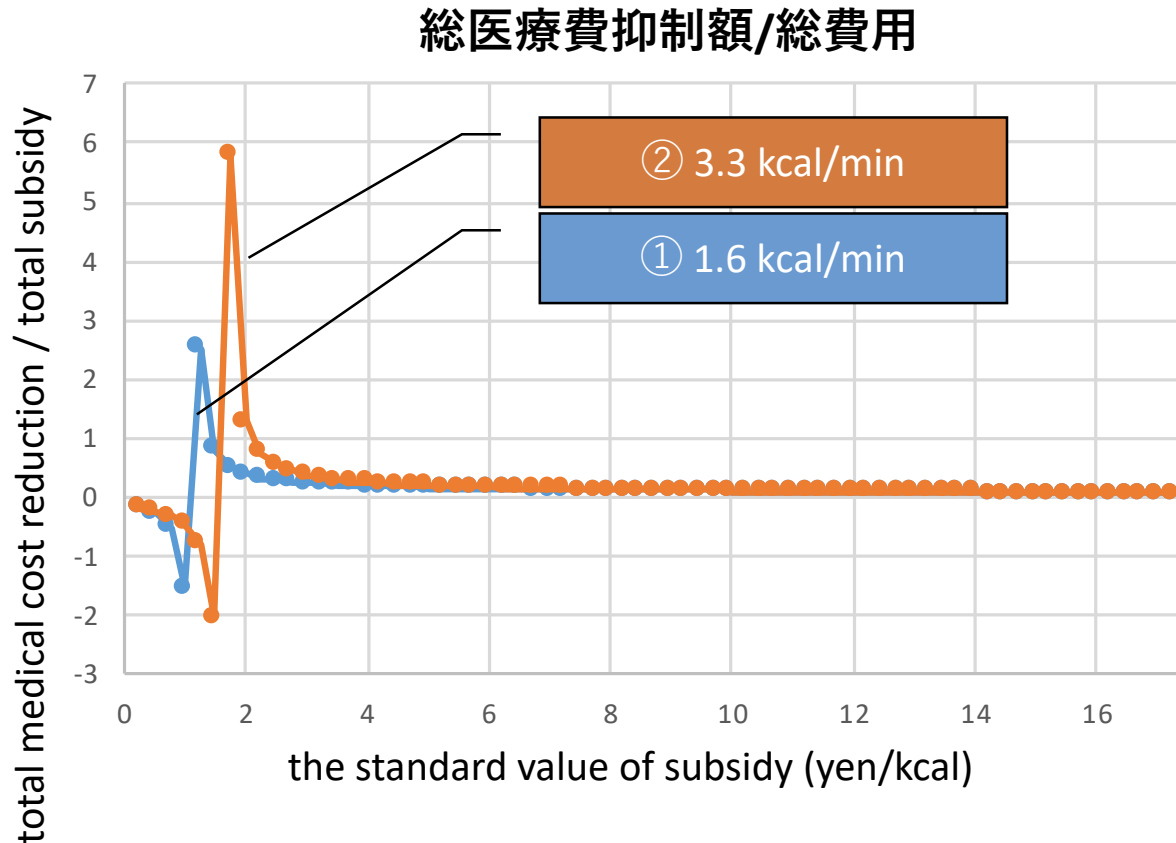
$$3.3 \text{ kcal/min} - 1.7 \text{ kcal/min} = 1.6 \text{ kcal/min}$$

② 徒歩の消費カロリー一分(3.3 kcal/min)を所要時間に応じて課税

Tax on the walking calories burned according to the required time as the required time.

補助金額の検討

Consideration of subsidy



総医療費抑制額/総補助金が、①1.25 yen/kcal, ②2 yen/kcal以上で1を下回る
total medical cost reduction / total subsidy is less than 1 when ①1.25 yen/kcal ②2 yen/kcal