WILLINGNESS TO PAY FOR A PUBLIC HEALTH CHECKUP PROGRAM:
ASSESSMENT BY THE TRAVEL COST METHOD

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Objective Whether the benefit of a public health program surpasses the cost of providing the program is an important question for public service providers. This study aimed to evaluate one health checkup program provided by a municipal government by measuring the public's willingness to pay (WTP) for maintaining the program.

Methods A questionnaire-based study of a health checkup program targeting people joining the National Health Insurance system was conducted. The WTP was estimated from a demand curve for the program, which was constructed by a revealed preference method, that is, by the travel cost method.

Results The WTP was calculated as 5410 yen per person, an amount substantially below the cost to the government of providing the service. The aggregate WTP was also estimated to be lower than the current expense of the municipal government.

Conclusion The amount users are willing to pay for a health checkup program provided by the municipal government appears to be less than the actual cost of the program. The travel cost method might reflect short-term private benefit produced by the health checkup program but cannot take into account long-term private benefit or overall social benefits which ensues.

Key words: health checkup, benefit, willingness to pay, travel cost method

I. Introduction

Economic evaluation of healthcare programs provided by the public sector has become important in Japan because many municipal governments are experiencing financial difficulties. Many cities in Japan provide yearly health checkups for residents, but the benefit produced by these programs has not been evaluated sufficiently.

In welfare economic theory, benefit is defined as *the individual's maximum willingness to pay (WTP) for a program*, and benefit from the program is defined as *the sum of the WTP of all persons whose welfare is affected by the program*[1]. When the sum of the WTP for a program exceeds the social cost, the program is considered an acceptable use of resources.

We here evaluated the benefit of a particular public health checkup program provided by a municipal government by calculating city residents' WTP by means of the travel cost method[2~4].

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II. Methods

Study setting

The municipal government of S city, Tokyo, Japan, provides yearly health checkups free of charge to city residents. The program targets mainly residents covered by the National Health Insurance, although other residents are also permitted to participate. The National Health Insurance system was organized mainly for self-employed persons, part-time workers, and unemployed persons and nearly 37% of the population of S city is covered. Working persons usually participate in other health examination programs, which are provided by their employers. About 90% of health checkups provided by the city are performed at general clinics, and the remainder take place at the municipal health center. The city pays more than 20,000 yen per program participant to the clinics.

A questionnaire on the health checkup program was developed and sent to 3510 randomly selected city residents (aged 40 to 69 years) who were mem-

bers of the National Health Insurance scheme. Questionnaires were distributed and returned between December 1, 2003, and January 31, 2004.

Provisions of the public health program

The health checkup includes a physical examination, blood pressure measurement, urine test, X-ray and electrocardiographic examinations, and a blood test (Table 1). After the health checkup, participants can attend an individualized counseling session to obtain the results of the checkup.

Questionnaire

The questionnaire on the health checkup program included questions covering demographic variables such as respondent age, sex, occupation, and annual income. WTP-related questions covered travel time and travel expenses to the place where the checkup occurred, the duration of the health checkup (including waiting time), and the duration of the counseling session on the results of the checkup (including waiting time). Participants were also asked whether they had undergone a health checkup provided by the municipal government during the prior year. Additionally, subjects were asked open-ended questions about the maximum amount they would be willing to pay for the health checkup program. The items included in the health checkup and the rate at which unusual test results are detected were explained to inform respondents as they estimated their WTP for the program.

Measurement of WTP

WTP was measured by the travel cost method. WTP for the health checkup program was estimated from a demand curve for the program, which was constructed by plotting the expected number of participants against the provisional prices. The expected number of participants was obtained from a visit rate curve, which was constructed by plotting access costs for the health program against rates of participation among groups categorized by access costs. SPSS 11.0 J for Windows (SPSS Japan Inc) was employed to obtain the visit rate and demand curves.

Access cost for the program

Although residents can have a health checkup free of charge in S city, there is a cost to the individual, from an economic perspective. To undergo a checkup, he/she has to sacrifice business or leisure time and activities. The cost of time for a health checkup can be calculated by the individual's opportunity cost of time. We posited that the cost of participating in the health checkup program consists of six components: the time cost for the checkup itself (T1), time cost for traveling to and from the healthcare facility (T2), monetary cost of traveling to and from the healthcare facility (M1), time cost of receiving counseling regarding the results (T3), time cost of traveling to and from the counseling session (T4), and monetary cost of traveling to and from the counseling session (M2). Total access cost was calculated as the sum of T1, T2, T3, T4, M1, and M2.

Study subjects

Out of the 3510 randomly selected questionnaire recipients, 1432 persons completed the questionnaire and gave written informed consent to participate in the study (response rate of 40.8%). Of these, 1349 were included in the analyses; excluded were 26 persons whose unit time cost could not be estimated because of a lack of information, 13 persons whose annual income was more than 100 million yen, and 44 persons who did not answer the questions on travel time or travel expense.

Cost measurements and subject groups

1) Unit time cost

The unit time cost for individual subjects was

Table 1. Components of the annual health checkup provided by S city.

Item	Details
Physical examination	Height, weight
Blood pressure measurement	
Urine test	Sugar, protein, occult blood
Blood test	Total cholesterol, HDL cholesterol, triglyceride, GOT, GPT, γ-GTP, ZTT, ALP, plasma glucose, uric acid, creatinine, amylase, total protein, albumin, hemoglobin A1c, complete blood cell count
Electrocardiographic examination	
Eyegrounds observation	
Sputum cytologic test	
Chest X-ray examination	
Medical examination by a physician	Interview, auscultation

calculated by one of three methods, depending on which respondent group was being considered. The first group comprised 625 respondents whose annual income was 2 million yen or more. In this group, the unit time cost of 1 hour was calculated as annual income divided by the average stated substantial working time provided by the Japan Institute for Labor and Training (1980 working hours per year)[5]. The second group comprised 678 respondents who were homemakers, part-time workers, persons without a regular job, and persons whose annual income was less than 2 million yen. For this group, the time cost of 1 hour was considered to be equal to 1000 yen. The third group comprised 46 respondents who had a regular job and did not report their annual income. Annual income for this group was calculated on the basis of age and sex according to data provided by the Japan Institute for Labor and Training[5]. The unit time costs of 1 hour for men were estimated as 3249 yen for persons aged from 45 to 49 years, 3304 yen for persons aged from 50 to 54, 3140 yen for persons aged from 55 to 59, 2195 yen for persons aged from 60 to 64, and 1996 yen for persons aged from 65 to 69. The unit time costs of 1 hour for women were estimated as 1892 yen for persons aged from 40 to 44 years, 1842 yen for persons aged from 45 to 49, 1800 yen for persons aged from 50 to 54, 1739 yen for persons aged from 55 to 59, 1426 yen for persons aged from 60 to 64, and 1555 yen for persons aged from 65 to 69.

2) Travel time and expenses

The median amounts of time necessary to undergo a health checkup and to receive counseling were calculated from values reported in the questionnaires. The travel expenses and travel times reported by the subjects were used in the economic analyses.

III. Results

Visit rates

Among the 1349 respondents, 610 persons had undergone a health checkup provided by S city during the prior year. The visit rates for men and women were 0.333 (150 out of 450) and 0.519 (418 out of 806), respectively. Values for persons aged 40 to 49 years, 50 to 59 years, and 60 to 69 years were 0.364 (68 out of 187), 0.415 (120 out of 289), and 0.492 (374 out of 760), respectively. The visit rates for seven annual income groups appear in Table 2. It can be inferred from the data that as annual income decreases, the visit rate tends to rise.

Time needed for a checkup and counseling

The mean and median amounts of time necessary for a health checkup reported by the 610 persons who had undergone a health checkup during the prior year were 62.3 minutes and 60 minutes, respectively. The mean and median amounts of time necessary for counseling sessions reported by the 610 persons were 43.3 minutes and 30 minutes, respectively. The median times were used to estimate the opportunity cost of time for participating in the health checkup program.

Access costs for the program and the visit rate curve

The 1349 respondents were divided into nine groups (A to I) according to individual access costs for the program (Table 3). Subjects whose access cost was very high elevated the mean access cost in group A, whereas mean cost and median cost were almost the same in the other groups. Median access costs were used for constructing the visit rate curve. The relation between the visit rate and the median access cost for the program is plotted in Figure 1. As the median access cost rose, the visit rate clearly decreased. The relation between the visit rate and

Table 2. Participation in the S city health checkup program stratified by income level.

Annual income (yen)	Number of respondents [Men, Women, NA]	Number of participants	Visit rate*
10,000,001+	22[18, 4, 0]	5	22.7%
7,000,001−10,000,000	40[27, 10, 3]	15	37.5%
5,000,001− 7,000,000	64[43, 16, 5]	30	46.9%
4,000,001− 5,000,000	52[39, 12, 1]	15	28.8%
3,000,001− 4,000,000	117[76, 36, 5]	55	47.0%
2,000,001− 3,000,000	211[128, 66, 17]	72	34.1%
0− 2,000,000	627[98, 480, 49]	309	49.3%
NA	216[21, 182, 13]	109	50.5%
Total	1,349[450, 806, 93]	610	45.2%

* Visit rate for the health checkup program during the prior year in each annual income group.
NA: no answer

Table 3. Access costs for the health checkup program and visit rates.

Group	Access Cost (yen)	Number of respondents [Men, Women, NA]	Number of participants [Men, Women, NA]	Visit rate [Men, Women]	Mean access cost (yen)	SD	Median access cost (yen)
A	20,001+	50[34, 11, 5]	10[6, 2, 2]	0.200[0.176, 0.182]	33,229.6	23,670.1	25,620
B	12,001−20,000	77[58, 16, 3]	17[11, 4, 2]	0.221[0.190, 0.250]	14,865.3	2,137.8	14,813
C	9,001−12,000	104[65, 32, 7]	27[16, 9, 2]	0.260[0.246, 0.281]	10,353.4	864.9	10,465
D	7,001− 9,000	116[55, 54, 17]	34[16, 17, 1]	0.293[0.291, 0.315]	7,906.9	527.4	7,951
E	6,001− 7,000	101[40, 52, 9]	31[11, 19, 1]	0.307[0.275, 0.365]	6,502.6	321.8	6,550
F	5,001− 6,000	128[46, 76, 6]	44[17, 26, 1]	0.344[0.370, 0.342]	5,477.2	324.0	5,439
G	4,001− 5,000	203[60, 126, 17]	94[27, 59, 8]	0.463[0.450, 0.468]	4,516.0	300.1	4,553
H	3,001− 4,000	200[43, 143, 14]	104[18, 79, 7]	0.520[0.419, 0.552]	3,531.7	302.4	3,476
I	2,001− 3,000	370[49, 296, 25]	249[28, 203, 18]	0.673[0.571, 0.686]	2,611.4	259.4	2,637
Total		1,349[450, 806, 93]	610[150, 418, 42]	0.452[0.333, 0.519]	6,484.2	7,663.7	4,557

SD: standard deviation of the mean, NA: no answer

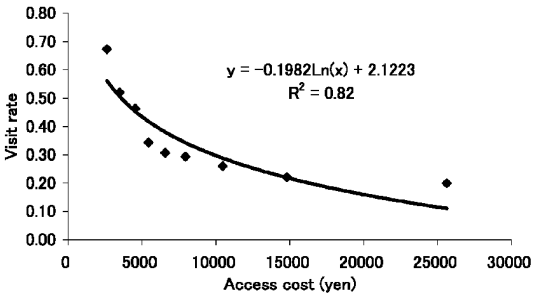

Figure 1. Visit rate curve for the health checkup program.

the access cost could be expressed by a non-linear formula:

$$VR = -0.1982Ln(C) + 2.1223 \quad (1)$$
$$(t = -5.7) \quad (t = 6.8)$$

where VR represents the visit rate for each group, C is the median cost for participating in the health program for each group, and t is the t value of the coefficient. The coefficient of determination, R^2, of the formula was 0.82.

Visit rate curves for men and women were expressed as $VR = -0.170Ln(C) + 1.838$ and $VR = -0.206Ln(C) + 2.213$, respectively. Although the coefficients of the formula were somewhat different between the sexes, formula (1) was used in the analysis.

Drawing a demand curve for the program

The visit rate curve was used to calculate the number of expected participants at 1000-yen increments of access cost up to 40,000 yen. In the original condition (price of the program was zero), the visit rate curve formula predicted 585 participants from the 1349 respondents. At a program price of 1000 yen, the expected number of participants was estimated to decrease from 585 to 530. At a program price of 2000 yen, the expected number of participants was estimated to be 486. At 40,000 yen, the expected number of participants would be 4. This calculation process is summarized in Table 4. A demand curve was obtained from the relation between the price of the program and the expected number of participants among the 1349 respondents (Figure 2). The demand curve was expressed by the formula:

$$P = 0.1269Q^2 - 137.17Q + 38121 \quad (2)$$
$$(t = 15.0) \quad (t = -26.6) \quad (t = 61.6)$$

where P represents the price of the program, Q is the expected number of participants, and t is the t value of the coefficient. The coefficient of determination of the formula was 0.99.

Aggregate and individual WTPs

The sum of the WTP values for all subjects is expressed by the area bounded by the X-axis, the Y-axis, and the demand curve:

$$\text{Sum of the WTP} = \int_0^{585} (0.1269Q^2 - 137.17Q + 38121)\, dx$$
$$= 7{,}297{,}812 \text{ yen}$$

The WTP value per person was calculated as 5410 yen (7,297,812 yen ÷ 1349 persons = 5410 yen). The benefit-cost ratio (BCR) of the health program among the 1349 persons, from the municipal government's point of view, is expressed as BCR would equal 1 if the expense to the municipal government for 1 person were 12,479 yen and the administrative cost (A) were zero. However, the actual BCR must be quite low because the current expense to the government is more than 20,000 yen per participant and the administrative cost is never zero.

Table 4. Process of calculating the expected number of participants in the health checkup program.

Price＝0	Group	I	H	G	F	E	D	C	B	A	Total
	Access cost (C)	2,637	3,476	4,553	5,439	6,550	7,951	10,465	14,813	25,620	expected
(current status)	Visit rate(R)*	0.561	0.506	0.453	0.418	0.381	0.342	0.288	0.219	0.110	participants‡
	Number(N)**	370	200	203	128	101	116	104	77	50	
	Expected number of participants (R×N)†	208	101	92	53	38	40	30	17	6	585
Price＝1,000	Group	I	H	G	F	E	D	C	B	A	
	Access cost (C)	3,637	4,476	5,553	6,439	7,550	8,951	11,465	15,813	26,620	
	Visit rate (R)*	0.497	0.456	0.413	0.384	0.353	0.319	0.270	0.206	0.103	
	Number (N)**	370	200	203	128	101	116	104	77	50	
	Expected number of participants (R×N)†	184	91	84	49	36	37	28	16	5	530
Price＝2,000					Same calculations as above.						486
Price＝30,000					Same calculation as above.						61
Price＝40,000					Same calculation as above.						4

* Visit rate was obtained from the visit rate curve, $R = -0.1982\mathrm{Ln}(C) + 2.1223$. ** Number of respondents in each group. † Expected number of participants was calculated from the visit rate (R) multiplied by the number of respondents (N). ‡ Total number of expected participants is the sum of the expected participants in each group. The price and access cost values are in yen.

$$BCR = \frac{\text{Sum of the WTP of subjects}}{\text{Expense to government for 1 person}(X) \times \text{Expected number of visitors} + \text{Administrative cost}(A)} = \frac{7297812}{X \times 585 + A}$$

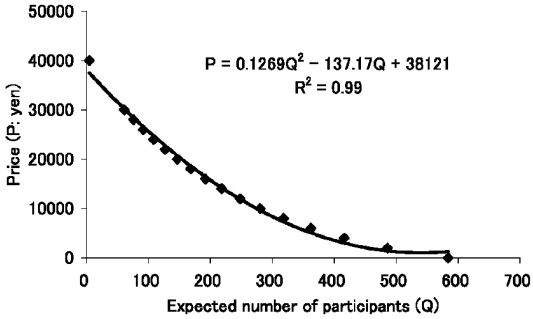

Figure 2. A demand curve for the health checkup program among the study subjects.

Sensitivity analysis on opportunity cost of unit time

For sensitivity analysis, we investigated how WTP would change if individuals' opportunity costs of unit time were higher than those calculated from the reported data (base case analysis). If individuals' opportunity costs of unit time were 10% higher than those in the base case analysis, the formula for the visit rate curve would change and the expected number of participants would be 608. In this case, the sum of the WTP was estimated as 8,473,784 yen. Under these circumstances, the BCR of the program would equal 1 if the expense of the government were 13,937 yen per person and the administrative costs were zero.

If individuals' opportunity costs of unit time were 20% higher than those in the base case analysis, the expected number of participants would be 628 and the estimated sum of the WTP would be 9,326,858 yen. The BCR of the program would then equal 1 if the expense for a person were 14,852 yen and the administrative costs were zero. The value of 14,852 yen is still lower than the current actual expense of the municipal government.

WTP obtained by open-ended question

Eighty-eight percent of the subjects (1191 out of 1349) answered the open-ended question about their WTP for the health program. The mean reported WTP was 4717 yen (standard deviation: 6485), and the median reported WTP was 3000 yen.

IV. Discussion

WTP for the healthcare program

The present estimation of aggregate WTP of questionnaire respondents for a health checkup provided by a municipal government revealed a value unlikely to be sufficient to cover the costs incurred by municipal governments that offer a health checkup program. The mean reported WTP (4717 yen) given in response to the open-ended question about WTP was somewhat lower than the individual

WTP generated by the travel cost method (5410 yen). The current situation, in which the health checkup is free of charge, might account for the lower WTP. Whatever the case, the monetary value of the respondents' WTP for the health checkup program was estimated to be much lower than the cost per participant incurred by the local government. Overall, we may have to accept the fact that residents are unlikely to regard the health program as being worth the cost. When the cost of a program exceeds the benefit, the value of the program must be carefully assessed. Maintaining a less beneficial program can necessitate sacrificing other beneficial programs to meet budget requirements.

If a health program provides external benefits, the social benefit from the program is larger than the aggregate of the individuals' WTP[2]. Health checkups provided by the public sector were originally aimed at preventing infectious disease, namely tuberculosis, which was a major public health issue in Japan until several decades ago. The existence of a large positive externality can justify support of the program even if the aggregate WTP is low. However, the current incidence of tuberculosis is so much lower than it was when the healthcare program was started, that the external social benefit of the program has probably decreased considerably.

If a public service can reduce a future cost to an amount equal to the current provision cost, continuation of the public service would be considered acceptable. Improved individual health resulting from early detection of illness can prevent future discomfort and may decrease future medical costs. In a context in which most medical expenses are paid by means of public medical insurance, decreased medical costs contribute to social benefits. Improving individuals' health may also decrease the cost of long-term care. A cost comparison study is therefore needed to evaluate the overall long-term cost reduction produced by the health program.

It is plausible to conclude that the low WTP obtained in this study was mainly an expression of the value individuals placed on obtaining information about their own health[6]. In other words, it likely reflects the value placed on a hypothetical referral to a treatment program for which the need and good outcome are also hypothetical. A health checkup provides information on health status but does not necessarily guarantee improved health. Presumably, the respondents in the present study estimated their own WTP on the basis of the value they placed on obtaining information on their health status and on beginning any necessary treatment as early as possible. WTP for improved health expected to be achieved via early treatment may not be included in the estimates.

The revealed preference approach might show short-term private benefit produced by a health checkup program but cannot take into account long-term private benefit or overall social benefits produced by the program. These would require multi-factor analysis and should be verified; if researchers cannot confirm the social value, the cost of the program to the municipal budget might not be supported by taxpayers.

Measurement of WTP

Roughly classified, there are two methods for measuring WTP: the revealed preference method and the stated preference method[7]. The wage-risk[8,9], hedonic pricing[2,10], and travel cost methods[2~4] are classified as revealed preference methods. The contingent valuation method[11~14] is based on the stated preference approach; respondents are asked to consider the contingency of a market existing for the thing being valued[14]. The WTP estimated in the present study is a value determined by the travel cost method, which is commonly used to estimate the benefit of recreation facilities, such as parks[8]. The key questions associated with this method are how to estimate the visit cost and how to construct a visit rate curve. We estimated the access cost of a health checkup program using individual opportunity cost of time and travel expense. Several authors have shown that travel expense is important in the medical care demand curve[14~16]. A weak point of the method used in the present study is that results depend heavily on the estimates of individual opportunity cost of time which require sensitivity analyses. Even when individual opportunity cost of time was set at 120% of the base estimates, the benefit derived from the public provision of a health checkup was found likely to be lower than the cost to the municipal government of providing the program. Another important consideration is that visit rate curves may differ according to subject characteristics such as age, sex, and occupation. In the present study, the visit rate curve for men would likely have differed from that for women, although the difference might not have been great. Visit rate curves did not appear to differ by subject age. Occupation or other factors possibly influence the form of the visit rate curve; however, no difference was confirmed in our study. If visit rate curves differ according to subject characteristics, of course, demand curves for the health check up program will also similarly vary. This may impact on the aggregate value of individuals' WTP. A more complete analysis of the relation between subject characteristics and visit rates is needed. Furthermore, the revealed preference approach intrinsically ignores the WTP among altruis-

tic people who do not benefit from a public service but are willing to pay for supporting the service[17]. When WTP for public health service is estimated, such altruistic WTP should be included in the assessment.

Contingent valuation methods are popular in the field of public health[18~20]. Although clearly insufficient to qualify as a contingent valuation method, we asked an open-ended question about the maximum amount subjects would be willing to pay for the healthcare program. The most important thing in contingent valuation methods is to give participants the most complete information possible on the outcomes produced by the program. However, this study could not show real outcome of the health checkup program because of the difficulty of obtaining reliable long-term outcome data.

Our findings confirmed that participation rate tends to decrease as the access cost for a health checkup program rises. In our study, the estimated residents' WTP for the checkup program provided by the municipal government was much lower than the actual cost of providing the program. While the travel cost method might show a short-term private benefit produced by a health checkup program, it cannot take into account long-term private or overall social benefits. Thus, the positive social value of the health checkup program should be verified in the future.

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