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Effect of prosthetic treatment for missing teeth on utility score

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The purpose of this study was to determine the presence or absence of systematic errors in the utility scores of the deficient states and the respective utility scores of each deficient state with treatment intervention, for all Japanese, males, and females separately. Seventeen oral conditions (five missing tooth conditions and each condition with treatment interventions) were assumed. Utility scores calculated by the time trade-off method in a previous study were used. It was found that the utility score basically decreased as the number of missing teeth increased in the Japanese population as a whole and for both meles and females. The utility score increased with prosthetic treatment. Significant differences were found between full denture (FD)-implant over denture (IOD) and FD-implant-supported fixed dental prostheses (ISFDP) for males and between FD-IOD for females in the upper and lower edentulous. The results revealed significant differences in utility scores by deficiency status and the value of treatment intervention in the Japanese population as a whole and by gender. The results also suggest that prosthetic treatment is factors that improves one's utility score, and that there are differences in consultation behavior between meles and females depending on oral status. (J Osaka Dent Univ 2024; 58: 391-397)

Key words: Oral health related QOL; Utility score; Time Trade-Off

INTRODUCTION

In recent years, healthcare has entered a global revolution, and the value of medical technology has been questioned. In Japan, as in other countries, concerns about the breakdown of the market mechanism for medical care and the sustainability of universal health insurance are growing, and painful increases in the burden and reductions in benefits are inevitable. Health technology assessment (HTA) is an interdisciplinary research field that examines the impact of medical technology on health from economic, organizational, social, and ethical perspectives while considering possible alternatives.[1] Health economics is the academic foundation of this field. It compares and evaluates the medical benefits that patients gain from the application of medical technology and the costs required for those benefits, and is essentially a science that quantifies the relative value of medical technology and verifies the value for money of medical care.[2] Therefore, economic evaluation mainly aims not only to reduce medical costs but also to provide a fair approach from the viewpoint of value-based public policy, which is required by the times, and through this, to enable a fair evaluation of medical innovations.[3] Although there are many studies on health economics in the medical field,[4] studies in the field of oral health care are scarce. In conducting health economics research, there are several analysis methods, such as cost-minimization, cost-effectiveness, cost-utility, and cost-benefit analyses. Many research guidelines in other countries recommend the use of quality-adjusted life years (QALY) as an outcome measure in cost-utility analysis.[5] The utility score is a quality-of-life (QOL) measure

that enables the evaluation of health status. It is a one-dimensional concept of QOL and is expressed as a number between 0 and 1. In principle, a patient's health status is evaluated by setting death as 0 and perfect health as 1. For example, the health status due to blindness caused by diabetic retinopathy can be expressed as 0.7, making it possible to determine QOL among patients with various diseases on a single scale. This enables easy medical economic evaluation such as cost-utility analysis, which has been widely used in the field in recent years. In Japan, cost-utility analysis, a socioeconomic evaluation of cataract surgery, exists in the medical field.[6] In the oral field, the health-based economic evaluation of implants exists.[7-12] However, to date, few health economic evaluation studies have used the oral QOL scale, which is used worldwide as an effective measure. Furthermore, few QOL evaluation forms can calculate QALYs regarding the oral cavity.[13] Previously, the authors conducted a cost-effectiveness study on implants.[14] The General Oral Health Assessment Index (GOHAI) was used for assessing effectiveness in that study; however, it is not a utility score.[15, 16] A utility score is necessary to calculate QALYs.[17] It is recommended to use an index-type scale to reflect the values of the general population.[18] Therefore, utility scores were calculated for all oral states using the time trade-off (TTO) method.[19] The utility score was calculated by changing N years and then measuring the utility score as N/X at the point at which the two were considered to have approximately the same level of desirability. For example, if survival for 20 years with an edentulous jaw and 10 years with no missing teeth are equally desirable, the utility score of the edentulous jaw for that individual is 10/20＝0.5.[20] The study used measured utility scores[19] to determine whether there was systematic error there for each deficit condition and treatment intervention.

MATERIALS AND METHODS

Target population

A research company (Antelio Co., Ltd.) conducted the sample collection for data collection in September 2017.[19] Participants in the general Japanese population were surveyed using computer terminals. The respondents' demographic characteristics are presented in Table 1.[19] A total of 2,193 respondents were included in the analysis.[19] The participants were adjusted for age and sex and equally divided into groups according to each deficiency state. Regarding education, 1.1-1.8% of the participants were elementary or junior high school students, 27.8-38.2% were high school students, 20.0-24.0% were college students, and 40.4-14.4% were university or graduate students. Household income (JPY 10,000) was 3.2-4.6% for less than 100, 4.6-7.5% for 100-200, 18.6-22.1% for 200-400, and 15.7-20.0% for 400-600. Regarding employment, 24.6-27.3% of participants were full-time workers, 10.1-14.1% were part-time workers, 8.5-10.9% were self-employed or managers, 23.4-26.4% were homemakers, and 16.1-21.0% were retired.[19] The questionnaire was administered to each individual using the TTO method for each of the 17 hypothetical oral conditions (five missing-tooth conditions, each with a treatment intervention) presented on the computer.[19] As it was difficult for one respondent to respond to all 17 oral conditions, the population was divided into groups according to the following five types of tooth loss status: loss of lower right first molar (Group A), loss of bilateral lower molars (Group B), bilateral lower molars and premolars (Group C), lower edentulous group (Group D), and upper and lower edentulous groups (Group E).[19]

Measurement of utility score

The developed questionnaire directly measures respondents' preferences using the TTO method as the index scale.[19] The utility scores for each of the five missing-tooth states were as follows: loss of the lower right first molar (Total: 0.6970, Male: 0.6970, Female: 0.6980), loss of bilateral lower molars (Total: 0.6021, Male: 0.6045, Female: 0.6006), loss of bilateral lower molars and premolars (Total: 0.52525, Male: 0.5252, Female: 0.5254), lower edentulous (Total: 0.4305, Male: 0.4309, Female: 0.4293), and upper and lower edentulous (Total:

Table 1 Demographic characteristics of respondents

Demographic characteristic	Group A	Group B	Group C	Group D	Group E
Age	Respondents n (%)				
50-59	224(10.2)	220(10.0)	226(10.3)	213(9.7)	222(10.1)
60-69	216(9.8)	219(10.0)	217(9.9)	222(10.1)	214(9.8)
Sex					
Male	224(10.2)	220(10.0)	215(9.8)	220(10.0)	218(9.9)
Female	216(9.8)	219(10.0)	228(10.4)	215(9.8)	218(9.9)
Region					
Hokkaido	13(3.0)	19(4.3)	18(4.1)	19(4.4)	25(5.7)
Tohoku	22(5.1)	17(3.9)	25(5.7)	17(3.9)	19(4.4)
Kanto	182(41.4)	174(39.8)	191(43.1)	165(37.8)	192(44.0)
Chubu	68(15.5)	64(14.6)	53(12.0)	72(16.4)	68(15.6)
Kinki	81(18.3)	95(21.6)	98(22.3)	100(22.9)	84(19.3)
Chugoku	20(4.4)	16(3.6)	20(4.4)	29(6.6)	17(3.9)
Shikoku	9(2.1)	14(3.2)	6(1.4)	8(1.8)	9(2.0)
Kyushu	45(10.3)	40(9.1)	32(7.4)	25(5.7)	22(5.0)
Marital status					
Married	324(73.6)	333(75.9)	317(71.6)	317(72.9)	328(75.2)
Unmarried	68(15.5)	54(12.3)	62(14.0)	64(14.7)	59(13.5)
Divorced/bereaved	48(10.9)	52(11.8)	64(14.4)	54(12.4)	49(11.2)
Education					
Elementary or junior high school	5(1.1)	8(1.8)	6(1.4)	5(1.1)	6(1.4)
High school	131(29.8)	122(27.8)	154(34.8)	166(38.2)	137(31.4)
College	98(22.3)	99(22.6)	104(23.5)	87(20.0)	105(24.0)
University or graduate	206(46.8)	210(47.8)	179(40.4)	177(40.7)	188(43.1)
Current student	0(0)	0(0)	0(0)	0(0)	0(0)
Household income (JPY 10,000)					
＜100	19(4.3)	14(3.2)	18(4.1)	20(4.6)	16(3.7)
100-200	26(5.9)	33(7.5)	31(7.0)	25(5.7)	20(4.6)
200-400	82(18.6)	87(19.8)	98(22.1)	93(21.4)	88(20.2)
400-600	78(17.7)	69(15.7)	71(16.0)	71(16.3)	87(20.0)
600-1000	95(21.6)	80(18.2)	85(19.2)	75(17.2)	88(20.2)
1000-1500	35(8.0)	40(9.1)	33(7.4)	29(6.7)	43(9.9)
1500-2000	6(1.4)	9(2.1)	6(1.4)	8(1.8)	6(1.4)
＞2000	5(1.1)	6(1.4)	4(0.9)	6(1.4)	3(0.7)
unknown	94(21.4)	101(23.0)	97(21.9)	108(24.8)	85(19.5)
Employment					
Full-time worker	120(27.3)	113(25.7)	109(24.6)	115(26.4)	118(27.1)
Part-time worker	62(14.1)	60(13.7)	53(12.0)	44(10.1)	61(14.0)
Self-employed or manager	43(9.8)	48(10.9)	43(9.7)	42(9.7)	37(8.5)
Housemaker	103(23.4)	109(24.8)	117(26.4)	106(24.4)	114(26.1)
Retired	78(17.7)	75(17.1)	93(21.0)	88(20.2)	70(16.1)
Others	34(7.8)	33(7.6)	28(6.3)	40(9.2)	36(8.3)

Group A: Loss of lower right first molar, Group B: Loss of bilateral lower molars, Group C: Loss of bilateral lower molars and premolars, Group D: Lower edentulous, Group E: Upper and lower edentulous

0.4000, Male: 0.4044, Female: 0.3969) in Table 2.[19] This study was approved by the Ethics Committee of Osaka Dental University (110816). Statistical analysis of the calculated utility scores (Total, Male, Female) was performed using the Kruskal-Wallis test to determine the presence or absence of systematic errors in the utility scores for each of the five deficiency conditions. The Friedman test was used to determine the presence or absence of systematic errors in the utility score (Total, Male, Fe-

Table 2 Relation between the utility score, tooth loss (Total · Male · Female)

	n (Total)	Utility Score (Total)	n (Male)	Utility Score (Male)	n (Female)	Utility Score (Female)
Group A	440	0.6970±0.3768	224	0.6970±0.3764	216	0.6980±0.3764
Group B	439	0.6021±0.4054	220	0.6045±0.4043	219	0.6006±0.4049
Group C	443	0.5253±0.4022	215	0.5252±0.4022	228	0.5254±0.4015
Group D	435	0.4305±0.3955	220	0.4309±0.3955	215	0.4293±0.3948
Group E	436	0.4000±0.3906	218	0.4044±0.3912	218	0.3969±0.4130

Group A: Loss of lower right first molar, Group B: Loss of bilateral lower molars, Group C: Loss of bilateral lower molars and premolars, Group D: Lower edentulous, Group E: Upper and lower edentulous, Mean±SD

male) for each deficiency condition with the treatment intervention.

RESULTS

The results of the analysis of determination of the presence or absence of systematic errors for each of the five types of defect statuses ware as allows: the utility score decreased as the number of defects increased. However, there was no significant difference between groups D and E. The results were similar for male and female. Fig. 1-5 shows the results of the utility scores (Total, Male, Female) for each missing tooth and analysis of the presence of systematic errors. The utility scores for each treatment intervention for each deficiency condition are shown in Fig. 1-5; fixed dental prostheses

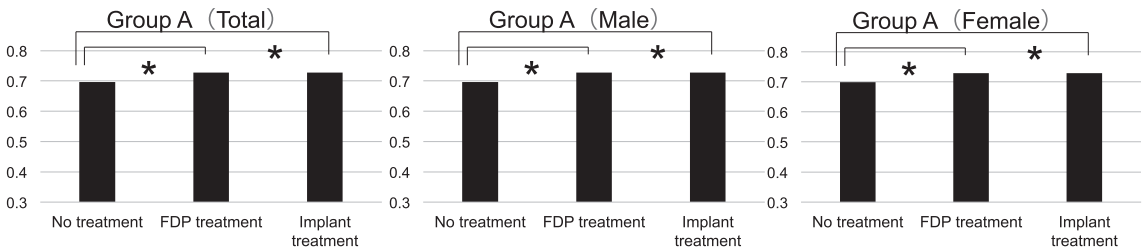

Fig. 1 Relation between the utility score, Group A treatment (Total · Male · Female) (*$p < 0.05$).

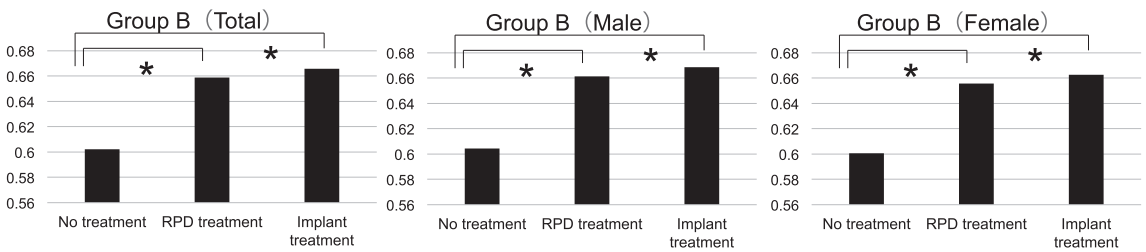

Fig. 2 Relation between the utility score, Group B treatment (Total · Male · Female) (*$p < 0.05$).

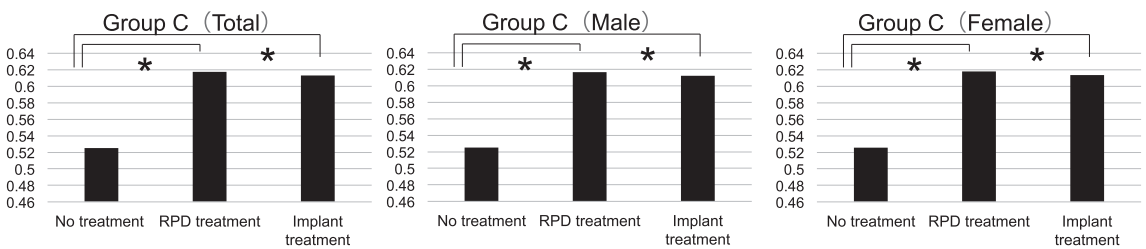

Fig. 3 Relation between the utility score, Group C treatment (Total · Male · Female) (*$p < 0.05$).

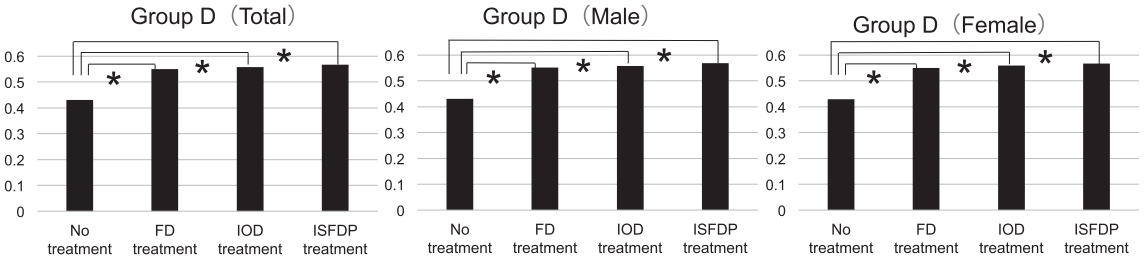

Fig. 4 Relation between the utility score, Group D treatment (Total・Male・Female) (*$p < 0.05$).

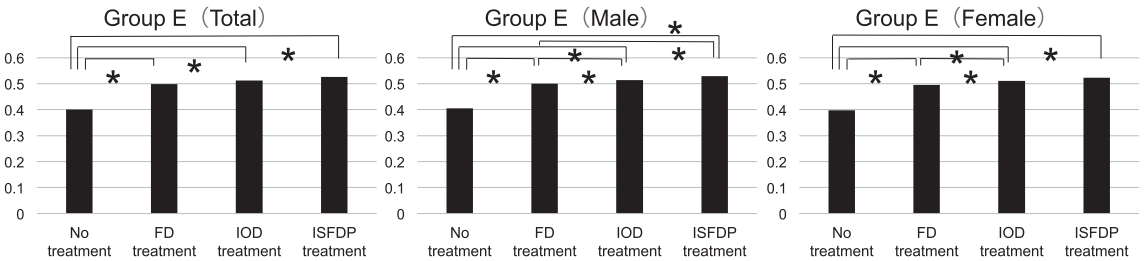

Fig. 5 Relation between the utility score, Group E treatment (Total・Male・Female) (*$p < 0.05$).

(FDP), removable partial denture (RPD), Implant, full denture (FD), implant overdenture (IOD), and implant-supported fixed dental prostheses (ISFDP) significantly improved the utility score. There were no significant differences in the utility score by each treatment method for the entire respondents. The results were similar for male and female, with the exception of Group E. In Group E (Male), significant differences were found between full denture and implant overdenture, also full denture FD and implant-supported FDPs. In Group E (Female), significant differences were found between full denture and implant overdenture.

DISCUSSION

Measurement of utility score

Cost-utility analyses in the medical field are well-documented in Japan.[20] For example, there are analyses of etanercept for rheumatoid arthritis[21] and pregabalin for patients with chronic pain[22] that use utility scores measured using the index scale EQ-5 D or SF. Specifically, in an analysis of etanercept for rheumatoid arthritis,[21] patients with rheumatoid arthritis were randomly assigned to receive etanercept 25 mg or methotrexate, and the utility score was evaluated based on the EQ-5D questionnaire. The results showed a 0.841 increase in QALYs in the etanercept group, suggesting that it was cost-effective. In the analysis of pregabalin in patients with chronic pain,[22] the utility score was evaluated based on the EQ-5 D questionnaire for the pregabalin and other groups (nonsteroidal anti-inflammatory drugs), and the results showed that the pregabalin group gained 0.763 QALYs and was cost-effective. The results suggested that pregabalin was the most cost-effective, with a QALY gain of 0.763. There is a lack of cost-effectiveness analyses in dentistry because very few studies have measured the utility score by oral status. Medical studies have reported that “tooth disorders” do not affect utility scores.[23] However, no utility scores have been calculated for missing teeth. This study suggests that tooth defects and treatment interventions affected the utility scores.

Oral health-related utility score

In summary, the utility score decreased as the number of missing teeth increased. However, there was no significant difference in utility scores between the edentulous mandible and edentulous maxilla. The results of this study allowed us to calculate a utility score for each oral condition that re-

flects the values of Japanese individuals. Prosthetic treatment improves the utility score of the Japanese population. This may assist patients in the selection of prosthetic devices. The fact that there was no significant difference in the utility score between the edentulous mandible and maxillary and mandibular jaws may indicate that Japanese individuals find it difficult to accept the edentulous jaws. Differences in the utility score were detected in the upper and lower edentulous jaws, depending on the treatment. IOD and ISFDP had higher utility scores than FD in males, and IOD had higher utility scores than FD in females. This study suggests that there are differences in medical examination behavior between males and females. The differences between full IOD and ISFDP included cost and surgical invasiveness. It seems that males may have more receptive values in this regard than females. It is possible that the respondents did not have a sufficient understanding of how to answer the questions in this survey. Thus, it is necessary to examine the validity and reliability of the questionnaire and consider surveying face-to-face, with one respondent per researcher. If the extent to which the oral environment affects QOL can be ascertained, along with establishing national standard values for each oral health condition and treatment intervention, further progress in health economic evaluation in Japan can be expected.

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