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Oral health-related quality of life assessment for various oral conditions

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We calculated the utility scores for various oral conditions using the time trade-off (TTO) method which is an index-type scale. A nationwide survey was conducted in Japan among the general population using the internet. The utility score was calculated for each participant using the TTO method for 17 hypothetical oral conditions presented on a computer according to five assumed tooth loss conditions and medical interventions for each. When we analyzed the survey responses obtained from 2193 individuals, we found that the utility score declined as the number of missing teeth increased for the different tooth loss conditions. Furthermore, a histogram of the data representing the utility score exhibited a bimodal pattern for all oral conditions, and the bimodal data shifted with medical intervention, showing an increase in the utility score. These results enabled the calculation of utility scores for oral conditions in Japanese individuals and demonstrated that tooth loss affected the utility score. (J Osaka Dent Univ 2023; 57: 63-69)

Key words: Oral health-related QOL; Utility score; Time trade-off; Cost-utility analysis

INTRODUCTION

Medicine has undergone a global revolution in recent years, with the focus on assessing the value of medical technology. Concerns regarding the failure of medical market mechanisms and the sustainability of universal health insurance have been increasing in Japan, as in other countries. Concerns over, the burden of cost and the reduction in benefits seems unavoidable. As a result, the concept of health technology assessment (HTA), which assesses the value of medical technology, has been developed.[1] HTA is an interdisciplinary field of research that examines the impact of medical technology on health from economic, organizational, social, and ethical perspectives. The purpose of HTA is to provide information for formulating patient-centric healthcare policies that are safe and effective, and to ensure optimal value. The field of medical economics forms the academic foundation of HTA. It compares and evaluates the medical effects of the application of different medical technologies and their necessary cost to the patients. The essence of this work is the science of quantifying the relative value of the medical technology and verifying the value-for-cost in healthcare.[2] Therefore, the primary purpose of economic evaluation is to not only reduce medical expenditures, but also to ensure a fair approach that stays current from a value -based, public policy perspective. This approach enables the objective evaluation of medical innovations.[3]

Although many studies have investigated medical economics, few have been conducted in the field of dentistry. The analysis methods used for conducting medical economics research include cost-minimization analysis, cost-effectiveness analysis, cost-utility analysis, and cost-benefit analysis. Many research guidelines in other countries recommend using the quality-adjusted life year (QALY) as an outcome index, which is used in cost-utility analysis (Table 1). A utility score must be calculated to use

Table 1 Classification of the analysis methods for medical economics research

Analysis method	Outcome type
Cost minimization analysis	Examining costs only, assuming equal outcomes
Cost-effectiveness analysis	Using outcome measures other than QALY, such as life years
Cost-utility analysis	Using QALY as outcome measure
Cost benefit analysis	Assessing outcomes by expressing them in monetary terms

QALY: Quality-adjusted life year

QALY. The utility score is a quality of life (QOL) scale that helps estimate health status. The utility score, ranging from 0 to 1, expresses the QOL as a one-dimensional concept. Generally, the patient's health status is designated a value between 0, representing death, and 1, representing perfect health. For example, the health status of a patient with blindness associated with diabetic retinopathy could be expressed as 0.7, allowing the QOL status of various diseases to be placed on a single scale. This simplifies medical economic evaluations, including cost-utility analysis, and has been widely used in this field in recent years. In Japan, a cost-utility analysis was performed for the socioeconomic evaluation of cataract surgery in the field of medicine.[4]

Medical economic evaluations related to dental implants have also been conducted.[5-9] However, there are limited medical economic evaluation studies in the field of dentistry using QOL scales, which have been widely implemented globally. There are few—if any—QOL evaluation forms for calculating QALY in the field of dentistry. We have previously investigated the cost-effectiveness of implants.[10] The General Oral Health Assessment Index was used to evaluate the study effect, though it is not a utility score system.[11, 12] A utility score is required to calculate QALY, and the use of an index-type scale has been recommended to reflect the values of the general population when calculating the utility score.[13] This study attempted to calculate the utility score for several oral conditions using the time trade-off (TTO) method.

MATERIALS AND METHODS

Target population

Data samples were collected in September 2017 by a marketing research company (Anterio, Tokyo, Japan). The survey targeted a sample of the general Japanese public and was conducted using the internet. First, a question sheet was prepared addressing 17 hypothetical oral conditions, according to five assumed tooth loss conditions and medical interventions for each. Responses to the question sheet were obtained from each participant using the TTO method for the hypothetical oral conditions presented by a computer.[14] The survey also collected information regarding the basic attributes of the respondents, such as marital status, education history, employment status, and household income. It would be difficult for a single respondent to answer questions addressing all 17 oral conditions. Hence, the responses were obtained by dividing the population into the following five tooth loss conditions: 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 arch; and Group E, upper and lower edentulous arches. The target number of survey respondents was set at 2000 and was adjusted according to sex and age. The 2011 Survey of Dental Diseases published by the Japanese Ministry of Health, Labor, and Welfare reported that the average number of missing teeth per person aged 45-49 years was 1.5.[15] In this survey, we decided to target respondents aged 50-69 years.

Calculation of the utility score

This study directly measured the preferences of the

respondents and developed a questionnaire using the TTO method, which is an index scale. The utility score (0: no satisfaction, 1: full satisfaction) was calculated for various tooth loss conditions and prosthodontic treatments, and was used as an efficacy index. The utility score was calculated using the TTO method as described below.[16] In a TTO valuation task the respondents are asked to trade off duration of life against health status. The trade-off entails choosing a shorter life spent in full health or living longer but in a lesser state of health. Often this is done by using an iterative process to offer the respondent different lengths of life before they indicate indifference. Intuitively, individuals would prefer to spend a shorter time in full health than a longer time in a lesser health state, and therefore they would trade off life years for better health. The number of years sacrificed in full health represents the value of the lesser state. To implement TTO, the preferences are elicited by giving the respondent a suboptimal health state of a given duration (X, often 10 years). As the competing alternative, a better health state (conventionally perfect health) is offered but with a shorter duration (N, which is less than 10 years). In the TTO exercise, the 10-year period is conventionally followed by death. The respondent is asked to state the duration spent in perfect health (N) at which he/she is indifferent between the duration N and the 10 years in the lesser health state. The value of the lesser state can then be established as N/10 (Fig. 1).

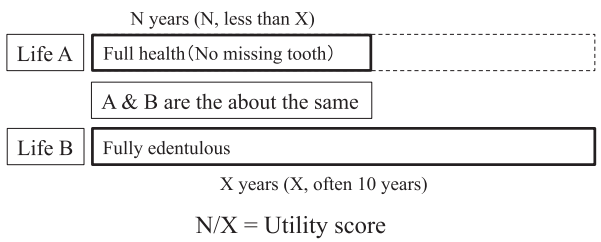

Fig. 1 Example of the assessment index using the time trade-off method.

This study was conducted with the approval of the Ethics Committee of Osaka Dental University (Approval No.110816).

RESULTS

The demographic characteristics of the study participants are summarized in Table 2. The survey responses obtained from 2193 participants were analyzed. The respondents were adjusted according to age and sex, and distributed equally into the five tooth loss groups. Kanto was the most common geographical region in all groups. Of the respondents, 73.8% were married, 14.0% unmarried, and 12.1% divorced/bereaved. The highest level of education for 1.4% of the participants was elementary or junior high school, high school for 32.4%, college for 22.5%, and university or graduate school for 43.8%. No participants were currently studying. 4.0% of the participants had an annual household income of less than 100 million (M) Japanese yen (JPY), 6.1% between 100-200 M, 20.4% between 200-400 M, 17.1% between 400-600 M, 19.3% between 600-1000 M, 8.2% between 1000-1500 M, 1.6% between 1500-2000 M, and 1.1% greater than 2000 M. The income was unknown for 22.1% of the participants. The employment status of the study cohort was 26.2% full-time, 12.8% part-time, 9.7% self-employed or manager, 25.0% housemaker, 18.4% retired, and 7.8% others.

The results for analysis of the utility scores are summarized in Table 3. The utility score declined as the number of missing teeth increased based on the assumed tooth loss conditions. For example, if the utility score for the loss of a tooth is 0.7, that would mean the participant is basically satisfied with this situation. The utility score for loss of the mandibular right first molar was 0.6970, 0.6021 for loss of bilateral mandibular molars, 0.5253 for loss of bilateral mandibular molars and premolars, 0.4305 for an edentulous mandible, and 0.4000 for a fully edentulous condition. The utility score increased with medical intervention as the tooth loss status increased, including fixed dental prostheses (FDP), removable partial dentures, implants, full dentures, implant overdentures, and implant-supported FDPs (ISFDPs). The histogram for the QOL exhibited a bimodal pattern for all oral conditions, with representative examples shown in Fig. 2.

Table 2 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 school	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 annual income (Japanese yen x 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 mandibular right first molar, Group B: Loss of bilateral mandibular molars, Group C: Loss of bilateral mandibular molars and premolars, Group D: Edentulous mandible, Group E: Fully edentulous.

Table 3 Relation between the utility score, tooth loss and treatment

	Respondents(n)	Utility Score
Group A		
No treatment	440	0.6970±0.3768
FDP treatment	440	0.7277±0.3777
Implant treatment	440	0.7275±0.3799
Group B		
No treatment	439	0.6021±0.4054
RPD treatment	439	0.6587±0.3909
Implant treatment	439	0.6656±0.3967
Group C		
No treatment	443	0.5253±0.4022
RPD treatment	443	0.6174±0.3960
Implant treatment	443	0.6129±0.4049
Group D		
No treatment	435	0.4305±0.3955
FD treatment	435	0.5502±0.4079
IOD treatment	435	0.5577±0.4082
ISFDP treatment	435	0.5676±0.4099
Group E		
No treatment	436	0.4000±0.3906
FD treatment	436	0.4978±0.4087
IOD treatment	436	0.5123±0.4152
ISFDP treatment	436	0.5257±0.4139

FPD: Fixed partial denture, RPD: Removal partial denture, IOD: Implant overdenture, ISFDP: Implant-supported fixed dental prostheses, FD: Full denture, Mean±SD.

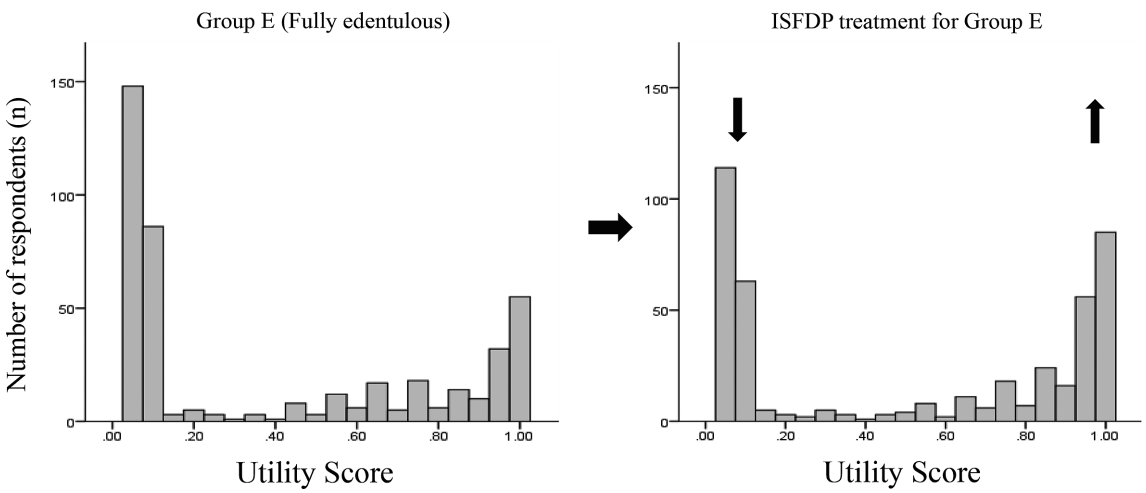

Fig. 2 Histograms for fully edentulous patients and implant-supported fixed dental prosthesis treatment.
Though the histogram for the QOL exhibited a bimodal pattern, the utility score increased with medical intervention as the tooth loss status increased.

Treatment intervention with ISFDP for the fully edentulous patient resulted in a shift in the bimodal data, indicating a higher utility score.

DISCUSSION

Calculation of the utility score

Cost-utility analysis studies have been done in the field of medicine in Japan. These include analyses of the use of etanercept for rheumatoid arthritis[17] and pregabalin for chronic pain.[18] However, these studies used utility scores based on the index scales EuroQoL-5 Dimension (EQ-5D) and Short-Form Dimension. The study on etanercept for rheumatoid arthritis[17] randomly allocated patients with rheumatoid arthritis to receive either etanercept (25 mg) or methotrexate, and the utility score was evaluated using EQ-5D. Results revealed that the QALY in the etanercept group increased by 0.841, suggesting that the treatment was highly cost-effective. The study on pregabalin for patients with chronic pain[18] similarly evaluated the utility score using EQ-5D for one group given pregabalin and the other group given an alternative treatment such as non-steroidal anti-inflammatory drugs. The results demonstrated that the pregabalin group attained a QALY of 0.763 (0.727 for the other group), suggesting that the treatment was highly cost-effective. The lack of cost-utility analyses in the field of dentistry in Japan may be because very few studies measured utility scores for different oral conditions. A study in the field of medicine reported that dental disorders do not affect the utility score.[19] However, utility scores based on tooth loss status have not been calculated. The results of this study clarified that oral conditions do affect the utility score.

Oral health-related utility score

Based on our results, we found that the utility score declined as the number of missing teeth increased, and that the utility score could be calculated for prosthodontic treatment. Although the histograms exhibited bimodality, the utility scores were based on values; hence, it is assumed that the results showed variations as some individuals wished to live longer, while others wished to enjoy food. These results enabled calculation of the utility scores according to the oral conditions in Japanese, which will be helpful for patients selecting prosthetic devices. An issue to address in future studies is that respondents may not have fully understood how to respond to this questionnaire. Therefore, it is necessary to examine the validity and reliability of the questionnaire and consider conducting face-to-face interviews, with one respondent per interviewer. Ascertaining the extent to which the oral environment affects QOL and establishing national standards for each oral health condition could further enhance the evaluation of medical economics in Japan.

Conflicts of interest

The authors declare no conflicts of interest associated with this study.

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