

Estimating Quality Adjusted Life Year Loss of Persons Disabled by Stroke Using EQ-5D in Korea

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EQ-5D를 이용한 뇌졸중 장애인의 질보정수명 감소분 추정

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= Abstract =

목적: 뇌졸중으로 인한 장애인이 증가하고 있으나 이들을 대상으로 질보정수명을 구한 연구가 없었다. 이 연구의 목적은 일개 시에서 뇌졸중 장애인을 대상으로 EQ-5D로 그들의 건강 관련 삶의 질 수준을 평가하고, 우리나라 전체 뇌졸중 장애인의 QALYs 감소분을 추정하기 위하여 수행하였다.

방법: 2008년 3월을 기준으로 경주시 장애인 등록현황에서 50세 이상인 장애인 중 뇌졸중이 원인으로 파악된 982명을 대상으로 설문조사자들이 방문하여 대면면접조사를 통해 일반적 특성, 임상적 특성, EQ-5D 등의 자료를 수집하였다. 제4기 국민건강영양조사 에서 일반인구집단과 동반질환이 없는 군을 건강비교군으로 선정하여 성별, 연령별 표준화를 통해 비교함으로써 효용 가중치 차이를 구하였다. 이 효용 가중치 차이를 우리나라 전체 뇌졸중 장애인에 적용하여 전체 QALYs 감소분을 추정하였다.

결과: 대상자 982명 중 조사응답자는 566명으로 응답률은 57.6%였다. 여성, 70대 이상군에서 EQ-5D 지표값이 남성이나 60대 이하군에 비해 더 낮았고, 상대 비교군과의 차이도 크게 나타났다. 건강비교군과 일반인구집단 비교군과의 비교에 따른 전체 QALYs 감소분은 각각 연간 67,011.6 QALYs와 54,167.1 QALYs로 추정되었다.

결론: EQ-5D로 우리나라 전체 뇌졸중장애인의 QALYs 감소분을 추정하였고, 이 연구를 바탕으로 뇌졸중 장애인을 대상으로 한 공중보건정책의 집행이나 평가를 수행하여 보다 근거에 기반한 장애인 정책을 수행할 수 있을 것으로 생각한다.

Key words: HRQOL, Utility, QALY, Stroke, Persons disabled

* 접수일(2011년 6월 2일), 수정일(2011년 6월 23일), 게재확정일(2011년 6월 24일)

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* This work was supported by Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education, Science and Technology(MEST)(KRF-2007-331-E00053)

Introduction

The number of registered disabled persons was raised over two times from 950 thousands in 2000 to 2240 thousands in 2008 and it is expected to increase continuously due to the population aging and the expansion of the criteria of disability in Korea [1]. In particular, disability of brain lesion was included in the category of disability according to the expansion of the range in 2000. And the number of persons disabled from 30 thousand in 2000 from that time to 230 thousand in 2008[1]. Among many causes of brain lesion, stroke accounts for the largest portion or around 76.9% of total cases of brain lesion [2].

Health related quality of life(HRQOL) means quality of life related with health condition and perceived health conditions[3]. HRQOL measures can be divided into three-general health profiles, specific measures and preference based measures [4]. Out of them, preference based measure can obtain quality adjusted life years (QALYs) by calculating utility weight. A QALY is an index summarizing both life years and HRQOL. Utility weight is used for weight of QALY calculation, and generally '1' represents the perfect health and '0' means death. For example, one year in perfect HRQOL, i.e. state of utility weight equal to 1.0, assigned 1 QALY and other one year in a state of congestive heart disease of which utility weight is 0.5 equals to 0.5 QALYs. Therefore, in this case, 2 years in congestive heart failure equal to 1 year in perfect HRQOL. This QALY is useful for decision-making in the public health and the clinical sectors and for economic evaluation [4]. Preference-based measures widely used are EQ-5D [5], QWB[6], HUI mark3[7] and SF-6D[8].

Out of them, EQ-5D was developed by EuroQol group and consists of five dimensions such as mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension was assessed on a 3-point ordinal such as no problem, some or moderate problems, extreme problems [5]. EQ-5D has been a common tool to measure HRQOL of the general population and of patients with different diseases such as stroke[9] and diabetes [10]. In addition, valuation sets to calculate utility weight have been suggested in many countries including England [11], the U.S. [12] and Japan [13] using the time trade-off (TTO) method. In South Korea they were also developed by using TTO [14-16].

Although studies assessing HRQOL for stroke patients have been conducted in Korea [17-19], one previous study investigated the correlation between social support and general health profiles [17], another study were conducted with inpatients in one hospital [18]. The other study evaluated some of the general population submitting self-report [19]. But, there was no study measuring burden of disease of persons disabled by stroke in terms of QALYs.

The purposes of this study were to measure health related quality of life (HRQOL) of persons disabled by stroke dwelling in one community of Korea using EQ-5D and to estimate total QALYs loss of persons disabled by stroke in Korea.

Subjects and Methods

This study targeted persons disabled by stroke aged over 50 years among 1,332 registered as the disabled due to brain lesions in Gyeongju city in March, 2008. Of these, 350 excluded for incompatibility with brain tumor,

Table 1. Eligible and study subjects by gender and age.

	Eligible population		Study participants	
	Male, N (%)	Female, N (%)	Male, N (%)	Female, N (%)
50s	142 (25.9)	39 (9.0)	64 (19.2)	20 (8.6)
60s	173 (31.5)	144 (33.3)	118 (35.3)	86 (37.1)
70s	189 (34.4)	189 (43.6)	130 (38.9)	96 (41.4)
80 or over	45 (8.2)	61 (14.1)	22 (6.6)	30 (12.9)
Total	549 (100.0)	433 (100.0)	334 (100.0)	232 (100.0)
Mean age (SD)	67.2 (8.9)	70.7 (8.4)	67.8 (8.3)	70.2 (8.3)
Response rate			60.8%	53.6%

Parkinson disease, and brain injury. Out of 982 eligible subjects, 628 agreed to participate in this study. By excluding 62 not completing EQ-5D questionnaire, the data of 566 were finally analyzed. The final response rate was 57.6%(Table 1).

A questionnaire survey was conducted from June to October 2008. The government officials in charge of chronic disease control and nurses for customized visiting health care in public health centers performed the interviews after receiving educations on the survey. The interviewers informed the eligible subjects of the study by phone, and then visited their homes. This study was approved by Institutional Review Board (IRB) of Dongguk University Gyeongju Hospital.

To calculate QALY loss, comparison data for matching the age groups aged over 50 years were from the 4th Korea Health and Nutrition Examination Survey(KHNES)[20].

In addition, the difference in utility weight was investigated from two aspects. One is the estimated QALY loss from comparison with the healthy control group and the other is from comparison with the general population. First, in comparison with the healthy group, the QALYs loss_{healthy} was estimated using the formula (1).

The number of total disabled persons by

stroke was obtained by estimating disabled persons by stroke by age group based on the data of registration of disability due to brain lesion of the Ministry of Health and Welfare in 2008 [21] and National Survey of Disabled Persons in 2008 [2]. The proportion of stroke out of brain lesion by age group recorded 79.2%, 89.7% and 85.3% for the persons in their 50s, in their 60s and aged over 70 years, respectively [2].

$$QALYs\ loss_{healthy} = \sum_{a=1}^4 \left(\sum_{b=1}^4 UWma_{healthy} @ UWma_{stroke} \right) \sum_{c=1}^4 B Nm_a + \sum_{a=1}^4 \left(\sum_{b=1}^4 UWfa_{healthy} @ UWfa_{stroke} \right) \sum_{c=1}^4 B Nf_a \dots(\text{formula 1})$$

UWma_{healthy}: Mean utility weight of males of a age group without comorbidity in KHNES

UWma_{stroke}: Mean utility weight of males of a age group in the data of persons disabled by stroke

Nm_a: An estimate of males disabled by stroke in a age group of South Korea

UWfa_{healthy}: Mean utility weight of females of a age group without comorbidity in KHNES

UWfa_{stroke}: Mean utility weight of females of a age group in the data of persons disabled by stroke

Nf_a: An estimate of females disabled by stroke in a age group of South Korea

a: age group, 1-the 50s, 2-the 60s, 3-the

70s, 4-the 80s or older

Second, QALYs loss_{general} was calculated from comparison with the general population regardless of existence of comorbidity by using formula (2).

$$QALYs\ loss_{general} = \sum_{a=1}^4 \sum_{b=1}^4 UWma_{general} @ UWma_{stroke} B N m_a + \sum_{a=1}^4 \sum_{b=1}^4 UWfa_{general} @ UWfa_{stroke} B N f_a \dots \text{(Formula 2)}$$

UWma_{general}: Mean utility weight of males of a age group in the total data of KHNES

UWfa_{general}: Mean utility weight of females of a age group in the total data of KHNES

Personal characteristics such as gender, age, education and marital status and patterns of alcohol-drinking and smoking after the incidence of stroke were collected by questionnaire survey. And the data of degree of disability and comorbidity were collected by official or medical records. For the disability grade, the grade at the time of 2008 survey was used. Modified Rankin Scale (MRS) and Barthel Index(BI) were assessed by interviewers. To calculate QALYs weight, HRQOL was investigated with EQ-5D. To obtain utility weight or EQ-5D index, the EQ-5D valuation set developed by Lee et al.[14] in South Korea was primarily utilized.

Results

Among the subjects, males and females were 334(59.0%) and 232(41.0%), respectively. For age, the subjects in their 70s accounted for the largest portion in both of males and females. The difference in the distribution of eligible subjects and study subjects by gender was not statistically significant (p-value recorded 0.079 and 0.804 in males and females, respectively).

General and clinical characteristics of the participants are shown in Table 2. For educational background, the largest number of the males (111 persons, 33.2%) graduated elementary schools while the largest number of the females (106 persons, 45.7%) had no educational background. Although 82.6% of the males had their spouses, only 47.0% of the females answered that they had spouses. The rates of alcohol drinkers and smokers were 32.0% and 26.1% in males and 11.2% and 5.4% in females, respectively. When combined disease was investigated, hypertension ranked first in both of the males and the females(34.7% and 45.3%, respectively) and diabetes (53 persons, 15.9%), hyperlipidemia (20 persons, 6.0%) and backache (20 persons, 6.0%) followed it in the males while diabetes (35 persons, 15.1%), osteoarthritis (24 persons, 10.3%) and cataract (20 persons, 8.6%) did it in the females. Out of the males and the females, 53.0% and 43.5% reported no combined disease, respectively. Duration of disease was within five years in the largest number of the subjects. And the degree of disability was answered to be grade 2 (26.9% and 30.2%) and grade 3 (27.2% and 27.2%) of the males and the females, respectively. According to the assessment using MRS, its score was three points in the largest number of the males and the females (33.5% and 28.4%, respectively) and the mean score of Barthel index recorded 14.2 and 13.5, respectively.

The most common problems were usual activities and mobility(Fig. 1). In addition, the EQ-5D health states responded by the largest number of the subjects or 26% was '22222' complaining of some problems in all dimensions. As 22221, 33333, 33322 and 33332 followed it in the order, most of the participants were complaint to have problems in mobility, self-care and usual activities.

Table 2. General and clinical characteristics of study participants.

		Male, N (%)	Female, N (%)
Education	No	59 (17.7)	106 (45.7)
	Elementary	111 (33.2)	95 (40.9)
	Middle	57 (17.1)	21 (9.1)
	High or more	107 (32.0)	10 (4.3)
Marital status	Spouse	276 (82.6)	109 (47.0)
	No spouse	58 (17.4)	123 (53.0)
Drinking	Yes	107 (32.0)	26 (11.2)
	No	227 (68.0)	206 (88.8)
Smoking*	Current	86 (26.1)	12 (5.4)
	Former	176 (53.5)	15 (6.8)
	No	67 (20.4)	195 (87.8)
Frequent comorbidity	Hypertension	116 (34.7)	105 (45.3)
	Diabetes	53 (15.9)	35 (15.1)
	Hyperlipidemia	20 (6.0)	12 (5.2)
	Back pain	20 (6.0)	11 (4.7)
	Osteoarthritis	18 (5.4)	24 (10.3)
	Cataract	14 (4.2)	20 (8.6)
No of comorbidity	0	177 (53.0)	101 (43.5)
	1	84 (25.1)	58 (25.0)
	2 or more	73 (21.9)	73 (31.5)
Prevalent duration†	5 years or less	131 (39.7)	88 (39.1)
	6~10 years	114 (34.5)	76 (33.8)
	11 years or more	85 (25.8)	61 (27.1)
Disability grade	1	51 (15.3)	40 (17.2)
	2	90 (26.9)	70 (30.2)
	3	91 (27.2)	63 (27.2)
	4	56 (16.8)	37 (15.9)
	5	30 (9.0)	19 (8.2)
	6	16 (4.8)	3 (1.3)
Modified Rankin Scale	0	3 (0.9)	1 (0.4)
	1	39 (11.7)	22 (9.5)
	2	93 (27.8)	65 (28.0)
	3	112 (33.5)	66 (28.4)
	4	48 (14.4)	43 (18.5)
	5	38 (11.4)	34 (14.7)
Barthel index, mean (SD)		14.2 (6.4)	13.5 (6.8)

*There were missing data of 15 cases.

†There were missing data of 11 cases.

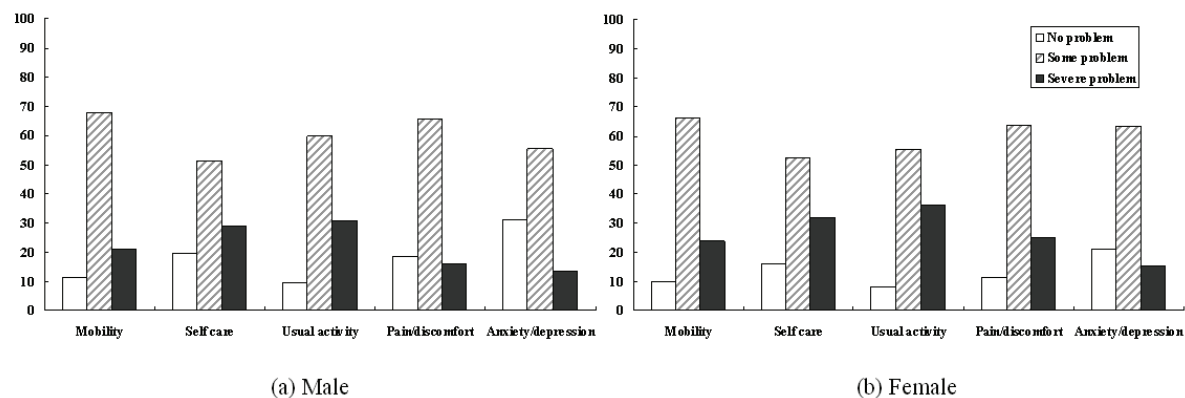


Figure 1. Responses on 5 dimensions of EQ-5D by gender

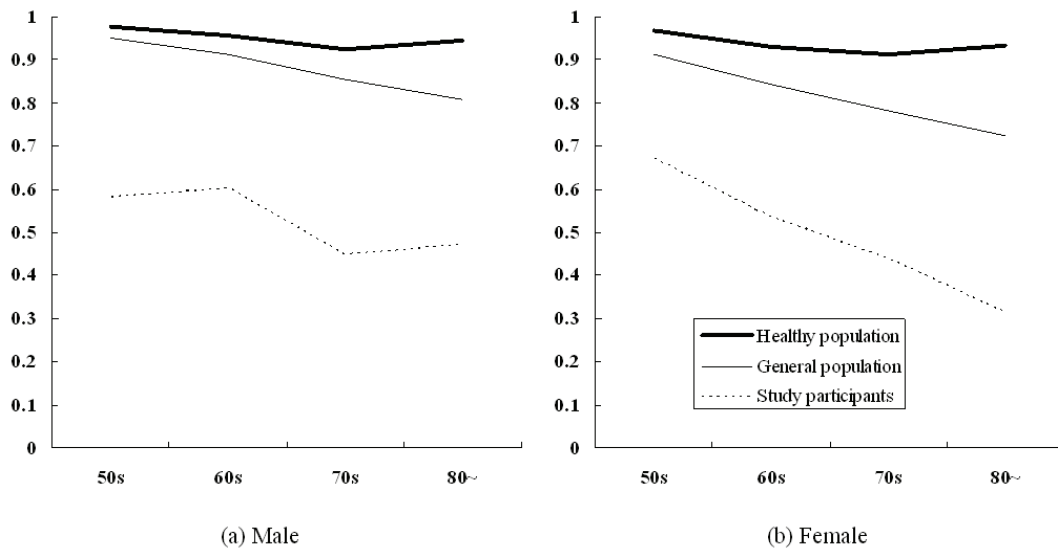


Figure 2. Utility weights of health population, general population, and study participants by age group

Table 3. Frequent EQ-5D health states of the study participants.

EQ-5D health states*	N	%
22222	147	26.0
22221	47	8.3
33333	32	5.7
33322	31	5.5
33332	23	4.1
23322	20	3.5
11111	18	3.2
22212	18	3.2
22211	13	2.3
21222	11	1.9
22322	11	1.9

* The five digits means five dimensions of EQ-5D health states, i.e. mobility, self care, usual activities, pain/discomfort, and anxiety/depression, and numerals 1, 2, and 3 in each digit represents no problem, some problems, and severe problems, respectively. Therefore, state of ‘22222’ in EQ-5D meant that there were some problems in all 5 dimensions of EQ-5D.

Estimating QALY loss

Difference in utility weight

The utility weights of the disabled persons by stroke, the healthy control group and the general population by age are shown in Fig. 2. The utility weights of the disabled group were outstandingly lower than those of the healthy control group and the general population. For males, the difference in utility weight between the healthy control group and the general

population was the largest in the participants in their 70s by recording 0.4760 and 0.4045, respectively. For females, the difference tended to increase with getting older so that it was the largest in the participants in their 80s by recording 0.6171 and 0.4076, respectively.

Estimating QALY loss

Estimates of QALY loss are presented in Table 4. In comparison with the healthy group,

Table 4. Estimating QALY (quality adjusted life year) loss in eligible and study subjects in comparison with health and general population

	Comparison with healthy population				Comparison with general population			
	Eligible population		Target population		Eligible population		Target population	
	Male (QALYs)	Female (QALYs)	Male (QALYs)	Female (QALYs)	Male (QALYs)	Female (QALYs)	Male (QALYs)	Female (QALYs)
50s	56.4	11.5	8536.5	3035.5	52.7	9.4	7967.1	2476.3
60s	61.3	56.5	12536.9	9037.7	53.8	44.3	11005.2	7076.9
70s	90.0	89.6	12274.2	12647.2	76.5	64.9	10430.5	9159.9
80 or over	21.4	37.6	2801.7	6141.9	15.2	24.9	1994.6	4056.8
Total	229.1	195.3	36149.3	30862.3	198.1	143.4	31397.3	22769.8
	424.4		67011.6		341.6*		54167.2*	

* This caused by rounding error.

QALY loss of disabled persons by stroke in Gyeongju-si and in South Korea were estimated as about 424.4 QALYs and 67,011.6 QALYs, respectively in 2008.

Moreover, in the comparison with the general population, the estimate was 341.6 and 54,167.2 QALYs, respectively. For the difference by gender, QALY loss was larger in males than in females in the comparison with both of the healthy control group and the general population

Discussion

This study was conducted to estimate QALY loss caused by stroke in Korea. To obtain utility weight, the total disabled persons by stroke in one city(Gyeongju-si) were eligible subjects and one on one interview was performed by visiting them directly.

The total response rate was 57.6%. Because there was no statistically significant difference by gender and age between the eligible subjects and the study subjects, the data of this study were considered to represent the total disabled persons by stroke well. By comparing these data with those of KHNES, the difference in utility weight by gender and age was examined and QALY loss was obtained by

multiplying the difference by an estimated number of disabled persons by stroke.

The disabled persons eligible for the study were all registered stroke in Gyeongju-si and the study subjects included all registered persons disabled by stroke in South Korea. When the eligible subjects and the actual respondents were examined by gender and age, the difference between the two groups was not statistically significant, and their distribution was found to be similar with that of the total disabled persons by stroke in South Korea [2]. Moreover, as the response rate recorded 57.6%, the data collected in this study were thought to be acceptable.

Analysis on health condition of persons disabled by stroke with EQ-5D revealed that most of the subjects experienced difficulties in usual activities and mobility. By considering that, the data of this study were thought to be collected appropriately. This tendency was similarly observed in general stroke patients. Fischer et al. [9] investigated HRQOL in patients with different types of stroke and found that the rate of complaining of problems related with usual activities was high although it was slightly different according to sites. In addition, it was observed in this study that utility weight was

lower in females, the score was lower in relatively older group and the difference in comparison with the healthy control group was higher in females and older group, as expected. A study of Jo et al. (2009) [18] also reported a similar tendency, although its results are hard to be compared with those of this study because it was conducted in a hospital. But, the rate of experiencing problems was higher in this study and that was considered to be because the participants of this study were registered disabled persons. For the MRS, most of the participants of this study recorded two or three points and nearly no one did 0 point while a half of the study of Jo et al. (2009) [18] recorded zero or one point. This difference also supports the interpretation mentioned above.

As expected, QALYs loss compared with healthy people larger than that loss compared with general population including some patients. The difference could be caused by self-reported prevalence of diseases. As results based on registered population, QALYs loss was 13.5 QALYs per 10,000 compared with healthy control group and 10.9 QALYs per 10,000 with general population in 2008, respectively.

This study analyzed the data by using the valuation set in a study of Lee et al.[14], but there were other two EQ-5D valuation sets in South Korea [15,16]. So, the estimates were calculated through the same method by using the tables in studies of Jo et al. (2008) [15] and Kang et al. (2006) [16]. Although the overall tendency was similar, but their QALY loss was larger than that using the valuation set of Lee et al. [14] by recording 75486.6 QALYs and 92467.4 QALYs, respectively. This finding shows that the calculated QALYs loss

can be different largely by valuation sets. According to a study on value evaluation in Europe, the difference among studies using Visual Analog Scale was relatively small but the difference among those using time-trade off method was larger [22]. Therefore, for studies on burden of disease or economic evaluation, it is needed to draw a conclusion after testing results of analysis using other valuation sets as well as a valuation set utilized in a primary analysis.

This study had some limitations. First, this study estimated the number of disabled persons by stroke by using the total number of registered disabled persons in South Korea and causes of disability by age. Although the number of the registered persons was considered to be similar with an actual number, whether stroke was a cause of disability was not clear. The cause was examined with National Survey of Disabled Persons, but it could produce some errors in estimates because its data did not classify the subjects in their 70s and aged over 80 years and into males and females. In addition, although HRQOL could be influenced by various factors including socioeconomic variables such as educational background and income, this study applied only standardization by gender and age, to estimate QALY loss in the total persons disabled by stroke in South Korea due to the lack of data.

Despite these limitations, this study is meaningful as it investigates HRQOL levels of persons disabled by stroke in a community directly by using EQ-5D or HRQOL measurement tool widely used around the world and it estimates QALY loss of the total persons disabled by stroke in South Korea by using the results. With a rapid population aging, the

number of persons disabled by stroke is expected to increase, so more researches are necessary for persons disabled by stroke to enjoy improved quality of life through interventions by monitoring their HRQOL and by determining factors affecting it.

Summary

The purposes of this study were to measure health related quality of life (HRQOL) of persons disabled by stroke dwelling in Gyeongju-si using EQ-5D and to estimate total QALYs loss of persons disabled by stroke in Korea.

The eligible subjects were 982 persons with stroke aged 50 and over in Gyeongju-si disabled registry, as of March, 2008. Interviewers measured HRQOL of study subjects using EQ-5D. EQ-5D index, utility weight, was derived from the Korean valuation set. In order to compare the results of this study, we selected two comparison groups representing Korean healthy population and general population of Korea using the 4th Korean National Health & Nutrition Examination Survey. Finally, after age and gender standardization, we estimated the total QALYs losses of persons disabled by stroke in Korea.

Of 982 eligible subjects, 566 persons participated in the survey (response rate: 57.6%). In both of female and male, utility weights in the 70s or 80s were lower than those of the 50s or 60s. Utility weights differences among persons with disability, general population, and healthy population in male were larger than those differences in female. Total estimated QALY losses of persons disabled by stroke were 67,011.6 QALYs lower than healthy

control group and 54,167.1 QALYs lower than general population, respectively.

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