Exploring the Score Equivalence of the English and Chinese Versions of the Brief Assessment Scale for Caregivers

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Abstract

Background: Multilingual outcome measures are used so that research studies are more generalizable across language contexts. **Objective:** To determine the score equivalence of the English and Chinese versions of Brief Assessment Scale for Caregivers (BASC) in Singapore. **Method:** Caregivers of patients with advanced cancer completed the BASC in either English or Chinese. Multivariable linear regression analysis was used to compare the mean BASC total and factor scores between the 2 language versions, with adjustment for possible confounding variables. Equivalence was declared if the 90% confidence interval of the mean scores fell entirely within an equivalence zone of ±0.5 standard deviation. **Results:** There were 521 ethnic Chinese participants, of whom 214 answered the English version and 307 answered the Chinese version. The BASC total and factor scores met the criteria for equivalence. Cronbach coefficients were similar and exploratory factor analysis showed similar 2-factor structures for both language versions. **Conclusion:** The English and Chinese versions of the BASC were found to be equivalent in terms of similar adjusted mean scores, Cronbach , and factor structures.

Keywords

caregivers, cancer, measurement

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Introduction

With multiethnic societies and globalization of research, there is a need for translated instruments to measure caregiver-reported outcomes (1). Changing global demographics indicate that the dominance of the English language will decline and multilingualism will be increasingly important (2). Multilingual instruments can be used to measure outcomes in different language groups so that research studies can be more generalizable across language contexts. To compare and aggregate results across these different language groups, equivalence between translated versions of the same questionnaire needs to be shown so that score differences will reflect real-group differences rather than measurement variability due to language versions (1,3–5).

The Brief Assessment Scale for Caregivers (BASC) is a 14-item questionnaire that was developed to measure the negative and positive aspects of the caregiving experience (6). It has the advantage of being shorter than other similar instrument, such as the CareGiver Oncology Quality of Life questionnaire that has 29 items and the Caregiver Reaction Assessment that has 24 items (7–9). As a shorter scale, the BASC is quicker and more feasible to be administered in both the clinical and research context. The BASC also includes a positive personal impact subscale, which is an important area to caregivers that other instruments generally do not address well (10).

The caregiving experience measured by the BASC is important as family caregivers of patients with cancer often face multiple challenges in their informal caregiving and may even have higher levels of unmet needs compared to patients (11–17). The simultaneous trends of longer survival, greater morbidity, and shorter hospital inpatient stays mean that many patients are primarily cared for in the community and that family members play a vital caregiving role (18,19). To measure this caregiving experience, the BASC was developed in English among caregivers of patients with medical illnesses such as advanced cancer (6). It was subsequently translated into Chinese and the Chinese version was validated in the population of Chinese caregivers in the United States (20). Therefore, the BASC can be administered in either English or Chinese, 2 of the commonest languages used in the world (2,21).

Although the English and Chinese versions of the BASC have been validated separately, equivalence between the 2 versions has not been reported. The overall aim of this study was to determine the score equivalence of the English and Chinese versions of BASC in Singapore (22–25). Secondary aims were to compare the internal consistency and factor structures for the 2 language versions.

Method

Study Setting and Participants

Singapore is a multiethnic society in Southeast Asia where English is the working language and medium of instruction in schools. Most Singaporeans are bilingual in English and a mother tongue. According to the census in 2010, 74.1% of the residents are of Chinese descent with Chinese as their mother tongue. It is estimated that in the Singapore population, 80% are English literate and 65% are Chinese literate (26).

The National Cancer Centre of Singapore provides care for approximately 65% of patients with cancer seen by government-linked health-care institutions in Singapore. A survey was conducted on family caregivers of patients with stage III or IV solid tumors to develop, validate, and establish the measurement equivalence of an English and Chinese version of a questionnaire for the assessment of caregiver health-related quality of life. In this study, a family caregiver was defined as a family member who was taking direct care of the patient's day-to-day and health-care needs or ensuring provision of care to meet the needs or was the decision maker with regard to the patient's needs and health care. Potential caregiver participants were approached when they were in hospital or in the outpatient clinic accompanying the patient. Participants chose to answer an English version or a Chinese version of the survey, according to their own preference. Surveys were self-administered where possible, and interviewer-administered otherwise, for example, poor eyesight or illiteracy.

In addition to the survey items measuring health-related quality of life, participants completed the BASC and selected items from the Functional Assessment of Cancer Therapy—General scale (27,28). The results pertaining to the development of the caregiver quality-of-life measurement scale will be reported elsewhere; this article reports the findings in relation to the score equivalence of the English and Chinese versions of the BASC. Only ethnic Chinese participants were included in this analysis to reduce the effect of unobserved confounding related to ethnicity.

The BASC Instrument

The English version of the BASC has 14 items with Cronbach α ranging from .71 to .88 for the total scale; it is a global measure of both negative and positive aspects of the caregiving experience (6,20). The BASC comprises 5 factors with Cronbach α ranging from .89 to .58 across factors: negative personal impact (items 2, 3, 4, 6, and 9), positive personal impact (items 11, 12, and 14), other family members (items 10 and 13), medical issues (items 7, 8, and 9), and concern about loved one (items 1 and 5) (6,29). The Chinese version of BASC was developed for Chinese family caregivers in the United States; it included 10 additional items that addressed language or cultural concerns of Chinese-speaking caregivers within the US health system (20). However, these additional items are not relevant for the Singapore context; for example, it can be lonely to be a Chinese caregiver in a Western medical system. Therefore, we used only the Chinese translation of the 14 items in the

English version. The English and Chinese versions of the BASC are available as online supplementary files.

Statistical Considerations

All items were coded such that a higher score reflected better caregiver outcomes. The 4-point Likert scales for the negatively worded items (items 1-10) were recoded as 3 (not at all), 2 (a little), 1 (some), and 0 (a lot of). Similarly, the "agree/disagree" scale of the positively worded items (items 11-14) were recoded as 3 (agree a lot), 2 (agree a little), 1 (disagree a little), and 0 (disagree a lot). Items 5 to 14 allowed for a "not applicable" (NA) response.

A mean score was calculated for each of the 5 individual factors as well as the total BASC. Items that were NA were not included in the analysis. The mean BASC score was computed by summing up the nonmissing and non-NA items in each factor, then dividing by the number of items that were not missing or NA. This gave a score scaled from 0 to 3, with a higher score indicating better caregiver outcomes. If all the items in an individual factor were missing or NA, then the factor score was not computed.

Demographic variables of caregivers and clinical characteristics of care recipients were compared between participants who completed the Chinese version and those who completed the English version. Student t test was used to compare age and χ^2 test was used to compare categorical variables such as education level and performance status. The performance status score ranged from "without symptoms" (0), "with symptoms; fully ambulatory" (1), "with symptoms; in bed less than 50% of the day" (2), "with symptoms; in bed more than 50% of the day, but not bedridden," to 4 (bedridden). The score 5 (death) was NA in the baseline survey (30).

Multivariable linear regression analysis was used to compare the mean BASC scores between the 2 language versions, with adjustment for gender, age, marital status, education level, relationship to the patient, whether the caregiver physically provided care to the patient, the performance status of the patient, whether the survey was self-administered, and setting of care (inpatient or outpatient). In a multiethnic society where the working language is English, language preference may be related to some of these factors such as age and education level, which may, in turn, be related to the experience of caregiving. Statistical adjustment was, therefore, performed to determine the effect of language without potential confounding by these other factors.

The 90% confidence intervals (CI) of the mean difference of BASC total and factor scores between the 2 language versions was estimated. Equivalence was declared if the 90% CI fell entirely within an equivalence zone. Nonequivalence was declared if the 90% CI was entirely outside the zone. The equivalence zone was defined as ±0.5 standard deviation (SD). This was based on a systematic review, which showed that the threshold of discrimination for

Table 1. Caregiver Participant Characteristics by Language Version of BASC.

Characteristic	English, n = 214	Chinese, n = 307	P Value[a]
Male gender	95 (44.4%)	116 (37.8%)	.13
Age, mean (SD)	46.3 (13.3)	51.0 (13.1)	<.01
Marital status			<.01
Married	140 (65.4%)	247 (80.5%)	
Single	65 (30.4%)	51 (16.6%)	
Divorced/separated/ widowed	9 (4.2%)	9 (2.9%)	
Education level			<.01
No formal education/ primary school	6 (2.8%)	81 (26.4%)	
Secondary school or ITE	53 (24.8%)	111 (36.2%)	
Postsecondary level (diploma, university degree, etc)	155 (72.4%)	115 (37.5%)	
Relationship with patient			<.01
Spouse	57 (26.7%)	139 (45.3%)	
Son/daughter	131 (61.2%)	115 (37.5%)	
Parent/sibling/other relative	26 (12.2%)	53 (17.3%)	
Caregiver physically provided care to the patient	141 (65.9%)	245 (79.8%)	
ECOG performance status of patient			.02
0	37 (17.3%)	27 (8.8%)	
1	78 (36.5%)	99 (32.3%)	
2	22 (10.3%)	42 (13.7%)	
3	53 (24.8%)	94 (30.6%)	
4	24 (11.2%)	45 (14.7%)	
Primary site of cancer			.82
Colorectal	50 (23.4%)	74 (24.1%)	
Lung	43 (20.1%)	57 (18.6%)	
Breast	22 (10.3%)	36 (11.7%)	
Prostate	17 (7.9%)	14 (4.6%)	
Pancreas	13 (6.1%)	15 (4.9%)	
Stomach	10 (4.7%)	18 (5.9%)	
Nasopharynx	8 (3.7%)	8 (2.6%)	
Ovary	7 (3.3%)	14 (4.6%)	
Liver	6 (2.8%)	15 (4.9%)	
Kidney	6 (2.8%)	8 (2.6%)	
Others	32 (15.0%)	48 (15.6%)	
Inpatient setting	120 (56.1%)	212 (69.1%)	<.01
Self-administration of survey	207 (96.7%)	265 (86.3%)	<.01

Abbreviations: BASC, Brief Assessment Scale for Caregivers; ECOG, Eastern Cooperative Oncology Group; ITE, Institute of Technical Education; SD, standard deviation.
[a]P value obtained from χ^2 test for categorical variables and Student t test for continuous variables.

changes in health-related quality of life was approximately half an SD (31). The limit of discrimination to 1 part in 7, which is approximately 0.5 SD, is also observed over a wide range of discrimination tasks, such as points on a line and saltiness of tastes (32).

The sample size of 300 per language group was decided for the main purpose of developing a new quality-of-life questionnaire for caregivers. Assuming the collinearity

Table 2. BASC Scores by Language Version, Equivalence Margin, and Adjusted Difference Between the 2 Language Versions.

| Characteristic | Score for English Version | | Score for Chinese Version | | Equivalence Margin (±0.5 SD) | English vs Chinese difference, Mean (90% CI) | |
	Mean (SD)	Number of Participants	Mean (SD)	Number of Participants		Unadjusted	Adjusted[a]
Total BASC score	1.95 (0.58)	214	2.01 (0.56)	307	±0.29	0.06 (−0.02 to 0.15)	0.13 (0.04 to 0.22)
Factor 1: Negative personal impact	2.00 (0.81)	206	2.03 (0.76)	295	±0.39	0.03 (−0.09 to 0.15)	0.16 (0.03 to 0.29)
Factor 2: Positive personal impact	2.41 (0.60)	189	2.55 (0.60)	270	±0.30	0.14 (−0.05 to 0.23)	0.06 (−0.04 to 0.16)
Factor 3: Other family members	2.39 (0.65)	203	2.45 (0.67)	284	±0.33	0.05 (−0.05 to 0.15)	0.07 (−0.05 to 0.18)
Factor 4: Medical issues	1.85 (0.97)	170	1.84 (0.84)	170	±0.45	0.01 (−0.^{17} to 0.15)	0.13 (−0.04 to 0.31)
Factor 5: Concern about loved one	0.95 (0.82)	213	0.98 (0.87)	302	±0.42	0.03 (−0.09 to 0.16)	0.22 (0.09 to 0.35)

Abbreviations: BASC, Brief Assessment Scale for Caregivers; CI, confidence interval; SD, standard deviation.
[a]Adjusted for gender, age, marital status, education level, relationship to the patient, whether the caregiver physically provided care to the patient, the performance status of the patient, whether the survey was self-administered, and setting of care (inpatient or outpatient).

arising from covariate adjustment would lead to a variance inflation factor of 3, the sample size of 300 per group would give a power of 90% using 90% CI for confirming equivalence within ±0.5 SD between the 2 language versions.

Cronbach α coefficients for the BASC total and factor scores were calculated for the English and Chinese versions of BASC, as indicators of internal consistency. Responses from participants with complete data were used to explore if the English and Chinese versions of BASC have similar factor structures. Exploratory factor analysis using iterated principal factor extraction with oblique promax rotation was conducted separately for the English and Chinese versions. A scree plot of the eigenvalues of the 14 factors was drawn. Parallel analysis was also conducted to determine the number of factors to retain (33). This was performed with 1000 simulation runs, based on 4-point scale data. We used the 95th percentile from the simulation data, analogous to choosing the conventional P value cutoff at .05.

Results

There were 521 ethnic Chinese participants, of whom 214 answered the English version and 307 answered the Chinese version of BASC. Participant characteristics were mostly balanced between the English and Chinese versions, except participants who completed the Chinese version were older (51.0 vs 46.3 years old), less educated (37.5% vs 72.4% with postsecondary-level education) and more likely to be the patient's spouse (45.3% vs 26.7%; Table 1).

Of the 521 participants, 294 had complete responses to all 14 items (148 for the English version and 146 for the Chinese version). Item 8 (discussing medical procedures if the patient's heart or breathing were to stop) accounted for most of the items marked "NA" (42/66 for English and 134/161 for Chinese). Of the 521 participants, only 33 (6.3%) had 2

items marked "NA" and a further 32 (6.1%) had 3 or more items marked "NA."

Comparing the scores for the English and Chinese versions, both the total BASC scores and each of the 5 factor scores met the criteria for equivalence, as indicated by 90% CI falling within the equivalence margins (Table 2). Furthermore, the covariate-adjusted difference between the 2 language versions was small, ranging from 0.06 to 0.22, corresponding to an effect size of approximately 0.1 SD to 0.25 SD only. Factor 5 (comprising item 1 relating to worry and item 5 relating to distress about the care recipient) had the largest adjusted difference (effect size) between the English and Chinese version, at 0.25 SD. Item 1 relating to worry about the care recipient had an adjusted difference of 0.18 (90% CI: 0.03-0.33), corresponding to an effect size of approximately 0.18 SD. Item 5 relating to distress about the care recipient had an adjusted difference of 0.25 (90% CI: 0.09-0.40), corresponding to an effect size of approximately 0.23 SD. The outcomes were worse in the English version compared to the Chinese version.

The Cronbach α for the BASC total score was .88 for the English version and .88 for the Chinese version (Table 3). For factor 3 (other family members), the coefficient was .41 in the English version and .47 in the Chinese version. Other factors had coefficients ranging from .68 to .86 in the English version and .71 to .82 in the Chinese version.

The factor structures for the English and Chinese versions were explored using the 294 participants with complete data. The scree plots of eigenvalues are shown in Figure 1. Two factors clearly stood out, with the top 2 eigenvalues being similar across the 2 language versions. The results of parallel analysis are summarized in Table 4. In both the English and the Chinese versions, only the first 2 factors had observed eigenvalues larger than the 95th percentile obtained from simulated data. The third largest eigenvalues we observed

Table 3. Coefficients for the Total BASC Score and Scores for Subdomains.

Characteristic	English Version	Chinese Version
Total BASC score	.88	.88
Factor 1: Negative personal impact	.86	.82
Factor 2: Positive personal impact	.84	.82
Factor 3: Other family members	.41	.47
Factor 4: Medical issues	.86	.72
Factor 5: Concern about loved one	.68	.71

Abbreviation: BASC, Brief Assessment Scale for Caregivers.

in the English and Chinese data sets were consistent with chance findings. Therefore, we decided to use a 2-factor solution for both the English and the Chinese versions. The factor loadings for the Chinese and English versions were similar, with items 1 to 10 loading on to one factor, which we call "burdens of caregiving," and items 11 to 14 loading on to another factor, which we call "rewards of caregiving" (Table 5).

Discussion

In order to use multilingual instruments in different language groups, comparability between versions needs to be shown. This study assessed the score equivalence, internal consistency, and factor structures of the English and Chinese versions of the BASC. Overall, the 2 language versions were

found to be equivalent in terms of similar adjusted mean scores, Cronbach α, and factor structures.

The mean and 90% CI for the BASC total and subdomain scores all fell within the equivalence zone defined as ±0.5 SD. The score difference between language versions for factor 5 (concern for loved one) was the highest, with better outcomes in the Chinese version, albeit the difference was only 0.25 SD and the 90% CI was still within the predefined equivalence zone. This factor comprised items 1 and 5: one relating to worry about the care recipient even when the caregiver was not with him or her and the other relating to distress overseeing the care recipient in so much pain or discomfort. The term "worry" in item 1 is translated to "yōu lù" (忧虑); the English version may be less negative than the Chinese version of the term, and this may be why English respondents rated higher extent of this bad outcome of being worried. Alternative Chinese term "dān yōu" (担忧) or "dān xīn" (担心) could be considered instead. Similarly, the English term "distressed" in item 5 may be less negative than the Chinese term "kǔ nǎo" (苦恼). Nevertheless, the differences in responses are considered small by Cohen definition (34).

Cronbach α coefficients for both the total and factor scores were comparable between the English and Chinese versions. When compared with the original BASC study, the current study reported higher internal consistency for the total BASC score and 4 of 5 BASC subscales, reinforcing the reliability of the scale for measuring burden in caregivers of patients with cancer. However, the Cronbach α coefficients were less than .5 for the "other family members"
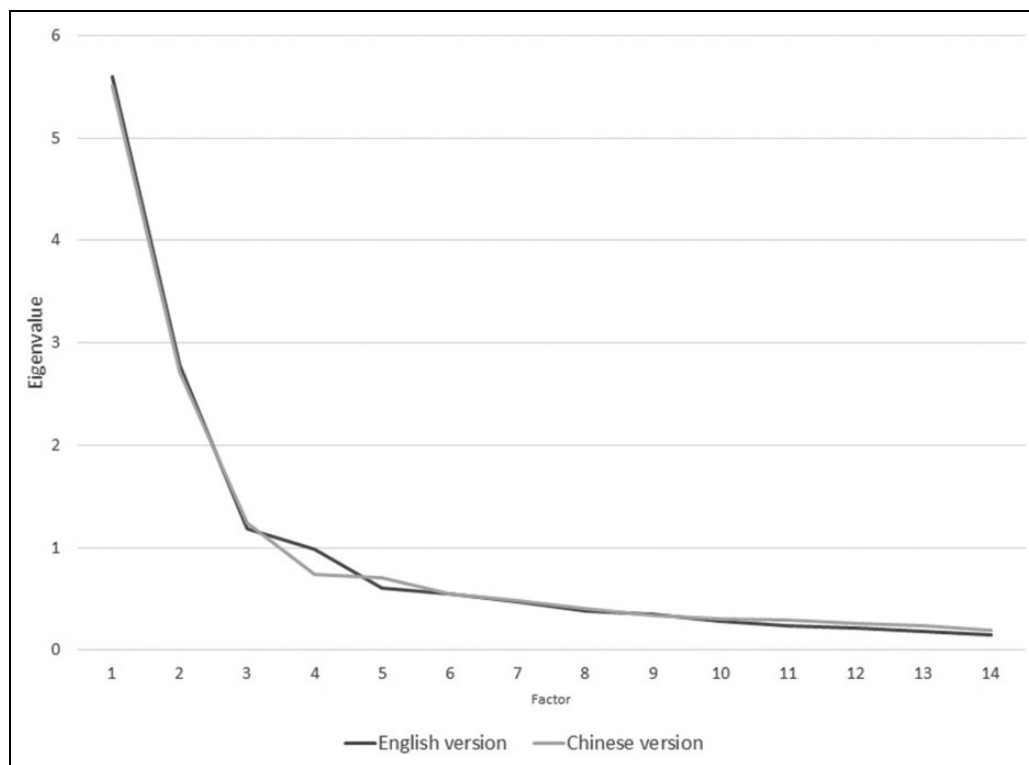

Figure 1. Scree plots of eigenvalues.

Table 4. Eigenvalues From Observed Data and Parallel Analysis of Simulated Data.

Number of Factors Retained	English Version		Chinese Version	
	Observed	Parallel Analysis	Observed	Parallel Analysis
1	5.60	1.56	5.51	1.69
2	2.78	1.41	2.71	1.52
3	1.19	1.32	1.25	1.39
4	0.98	1.24	0.74	1.29
5	0.61	1.18	0.71	1.21
6	0.55	1.12	0.55	1.13

Table 5. Factor Loadings of the English and Chinese Versions of BASC.

Items	English Version		Chinese Version	
	Burdens of Caregiving	Rewards of Caregiving	Burdens of Caregiving	Rewards of Caregiving
7: Making decisions	0.80		0.73	
8: Medical procedures	0.78		0.63	
6: Not enough time for your work	0.75		0.74	
2: Depressed	0.75		0.69	
4: Overwhelmed	0.74		0.83	
3: Not enough time for yourself	0.71		0.66	
9: Changed relationship with patient	0.69		0.53	
10: Strained relationships with other family members	0.66		0.59	
5: Patient's pain or discomfort	0.59		0.68	
1: Worried	0.52		0.55	
11: Drawn closer to patient		0.92		0.86
12: Brought meaning		0.86		0.83
14: Drawn closer to other family members		0.69		0.65
13: Feel good about myself		0.63		0.82

Abbreviation: BASC, Brief Assessment Scale for Caregivers.

factor, suggesting that the 5-factor structure in the original scale does not apply to our sample of caregivers of patients with advanced cancer in Singapore. This is confirmed by the factor analysis that yielded a 2-factor structure instead.

One possible reason for the difference in factor structure could be due to the difference in factor analysis methods used. The original US study employed principal components extraction with varimax rotation while we employed iterated principal factor extraction with oblique promax rotation. However, we found the same 2-factor structure in our study sample even when using other extraction and rotation methods.

Another possible reason could be cross-cultural factors such as family structure or level of acculturation among the different caregiver populations in Singapore and the United States. The "rewards of caregiving" factor in our 2-factor structure comprised all the items in the "positive personal impact" and 1 item from the "other family members" factors in the original 5-factor structure. The "burdens of caregiving" factor in our 2-factor structure comprised all items in the "negative personal impact," "medical issues," and "concern for loved one" and 1 item from the "other family members" factors in the original 5-factor structure.

It is not new that studies of patient-reported outcomes in Asia do not replicate the factor structure found in Western societies. For example, although the 8 subscales of the Short Form-36 Health Survey clearly form a physical and a mental component in 9 European countries and the United States, this pattern is not observed in Singapore and Japan (35–37). Previous qualitative research in Singapore found that the concept of "tòng kǔ" (痛苦, literally means "pain and bitterness") may be described as a "welding pain and suffering syndrome," suggesting a blurring between the physical and emotional experiences from an Asian cultural viewpoint (10). Taken together, health and quality-of-life constructs seem to be less compartmentalized in Asian culture, which may cause a difference in factor structure of patient- and caregiver-reported outcomes between East and West.

A limitation of the present study is that assessment of measurement properties that require longitudinal data, such as test–retest reliability and sensitivity to change, was not included. These were beyond the scope of this study, which focused on the score equivalence of the 2 language versions of the BASC. Another limitation was that the existing translated Chinese version of the BASC was used and cultural adaptation was not performed. However, using the exact same version has the advantage of allowing data across studies to be pooled and findings across studies to be compared. Furthermore, despite not having local adaptation, the Chinese version has demonstrated expected properties in this Singaporean study.

Conclusion

Our study findings were that the English and Chinese versions of the BASC demonstrated score equivalence. Internal consistency and factor structures were also comparable between the 2 language versions. Both globally and locally in Singapore, many people use Chinese as their first language (21,26). With the score equivalence of the English

and Chinese versions of the BASC confirmed, this instrument can now be used in Singapore and data from both language versions can be pooled for analysis. The findings also provide preliminary evidence that this instrument has the potential for use in other Chinese-speaking populations and facilitating cross-country comparisons.

When compared to the original BASC, Cronbach α coefficients were similar but there were differences in factor structure. The alternative 2-factor model in our study warrants further exploration. In addition, it would be advantageous to identify components of caregiver burden that are generalizable across countries. An international study could expand the sample size and increase global insight into caregiver burden in cancer.

Declaration of Conflicting Interests

Funding

Supplemental Material

Supplemental material for this article is available online.

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