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ORIGINAL RESEARCH

# Psychometric Properties of the Chinese Version of the Sarcopenia and Quality of Life, a Quality of Life Questionnaire Specific for Sarcopenia

**Xiaofeng Le[1] · Yao Wei[2] · Dingjun Hao[1] · Lequn Shan[1] · Xiaoli Li[2] · Qifang Shi[3] · Ding Ding[4] · Xiang Cheng[5] · Hwee Ling Eileen Lim[6] · Bao Yi Ng[7]**

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## Abstract

A quality of life questionnaire specific to sarcopenia (SarQoL®) was successfully developed. There is a huge demand for translation and validation in Chinese. The aim of this study was to translate the SarQoL® into Chinese and investigate its psychometric properties. The translation and cross-cultural adaptation process recommended by the developers of the initial questionnaire was followed. A total of 159 participants were investigated. The translation process consists of five steps: (1) two bilinguals independently translate initial English to Chinese; (2) synthesize the two translations into one; (3) backward translations; (4) expert committee review and (5) test of the pre-final version. The validation consists of three parts: (1) validity (discriminative power, construct validity); (2) reliability (internal consistency, test–retest reliability) and (3) floor and ceiling effects. There was no difficulty in translation process. Regarding the validity, good discriminant validity {quality of life for sarcopenic subjects [35.56 (29.73–42.70)] vs. non-sarcopenic ones [73.22 (60.09–82.90)], $p < 0.001$} and consistent construct validity [high correlations (spearman's r) of SarQoL® with generic Short Form-36 version 2 questionnaire (0.250 to 0.824) and EuroQoL-5-Dimension questionnaire ($-0.114$ to $-0.823$)] were found in SarQoL®. Regarding reliability, high internal consistency (Cronbach's alpha coefficient was 0.867) and excellent test–retest reliability (intraclass coefficient correlation was 0.997, 95% CI 0.994–0.998) were found. No ceiling/floor effect was reflected. A valid SarQoL® questionnaire is now available for Chinese population. It can provide a better understanding of the sarcopenia disease burden and serve as a therapeutic outcome indicator in research.

**Keywords** Chinese SarQoL® · Sarcopenia · Quality of life · Questionnaire

Xiaofeng Le and Yao Wei contributed equally to this study.

✉ Dingjun Hao
honghuispine@163.com

[1] Department of Spine Surgery, Honghui Hospital, Xi'an Jiaotong University, No. 555, YouYi East road, Xi'an 710054, Shaanxi, China

[2] Department of Geriatrics, Honghui Hospital, Xi'an Jiaotong University, No. 555, YouYi East road, Xi'an 710054, Shaanxi, China

[3] School of Nursing, Xi'an Jiaotong University, No. 28, Xianning West road, Xi'an 710048, Shaanxi, China

[4] Faculty of Humanities and Social Sciences, Xi'an Jiaotong University, No. 28, Xianning West road, Xi'an 710048, Shaanxi, China

[5] General Office, Shaanxi Bureau of National Food and Strategic Reserves Administration, No. 369, ChangYing West road, Xi'an 710012, Shaanxi, China

[6] Spatial and Furniture Design, Nanyang Academy of Fine Arts' 14, Visenze Pte Ltd, Blk 67 Ayer Rajah Crescent, Singapore 139950, Singapore

[7] Chemistry, National University of Singapore, No. 21, Lower Kent Ridge Road, Singapore 119077, Singapore

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## Introduction

Sarcopenia is a disease that is characterized by the age-related, progressive and generalized decline of skeletal muscle mass, muscle strength, and physical performance [1]. It leads to serious health problems, including physical disability, functional decline, depression, falls, fractures and death, and the related medical expense has brought great economic burden to the country and individuals [2–4].

Among Chinese individuals aged ≥ 60 years, the prevalence of sarcopenia ranged from 7.1% to 18.5% using the Asian Working Group for Sarcopenia (AWGS) criteria [1, 5–10]. There are more than 10 million patients with sarcopenia in China, and the number is still rising. This disease is becoming a major public health problem for aging society [11]. Therefore, the intervention of this disease is particularly important. At present, there have been a number of attempts in recent years for the treatment and prevention of sarcopenia, including nutrition and exercise [12]. However, evaluating and quantifying the efficacy of these therapies is always the priority during treatment, especially for the quality of life of sarcopenia patients.

Currently, SarQoL® (Sarcopenia and Quality of Life), an only quality of life questionnaire specific to sarcopenia, was developed. SarQoL® was initially developed and validated in French in 2015 [13, 14]. It was subsequently translated into English, Dutch, Romanian, Greek, Polish and other languages for validation [15–19]. China may have the largest number of sarcopenia patients in the world, but there is still a lack of validated SarQoL®, which hinders the development of sarcopenia research in China. Therefore, the aim of this study was to cross-culturally translate the SarQoL® into the Chinese language and investigate its main psychometric properties.

## Methods

### Study Population

Participants were recruited from community-dwelling elderly subjects or outpatient department of geriatrics in the Honghui hospital, Xi'an Jiaotong University, China. Inclusion criteria included age ≥ 60 years and Chinese mother tongue. Exclusion criteria include: (1) BMI (kg/m$^2$) ≥ 30; (2) participants with an amputated limb, or who were immobilized; (3) patients with an active malignancy; (4) patients with mental illness or inability to understand or fill the questionnaires, and other comorbidities known to have an impact on muscle mass and strength (malabsorption syndrome, Parkinson's disease, physical disabilities). The study was approved by the Ethical Committee of the Honghui Hospital, Xi'an Jiaotong University. All subjects were informed about the purpose and written informed consent was obtained.

### Assessment of Sarcopenia

Sarcopenia was diagnosed according to the approach of the AWGS 2019 consensus [1]. Sarcopenia was defined as: low skeletal muscle mass (SMM) + low muscle strength or low physical performance.

For SMM estimation, we used Lee equation [20]: $SMM = (0.244 \times \text{body weight}) + (7.8 \times \text{height}) + (6.6 \times \text{sex}) - (0.098 \times \text{age}) - 4.5$, where sex = 0 for female and 1 for male. The cutoff values were as follows: < 5.4 kg/m$^2$ for female and < 7.0 kg/m$^2$ for male patients. Muscle strength was evaluated as handgrip strength using a hydraulisches hand-dynamometer (SH5001, Saehan Corporation, Mansan, South Korea) with the following cutoff values, < 18 kg for women and < 28 kg for men. Each participant had two measurements with the dominant hand, and the mean value was used for further analyses. For physical performance, we used the gait speed test: the 6-m test walk. Values under < 1.0 m/s in gait speed indicated low physical performance.

### Translation and Cross-cultural Adaptation of SarQoL®

The translation and cross-cultural adaptation went through five phases according to specific guidelines [21]: (1) translation from English to Chinese was made independently by two bilingual with language Chinese as their first language. One of them had a medical background, and the other one was novice regarding the topic of the questionnaire; (2) the two translators then compared their translations, and provided a single "Version 1" of the translated questionnaire; (3) two independent translators reverse translations back into the English language. These translators were bilingual and had English as their first language and have no medical background; (4) the reverse translations were compared by an expert committee review with the original questionnaire, leading to a pre-final version of the SarQoL®-CN. This expert committee had two methodologists, one health professional, one Chinese professional, and the four translators (first and back translators) involved in the process; (5) test of the pre-final "version 2" on 10 sarcopenic subjects to ensure understanding of the purpose and meaning of each question, leading to the final version of the SarQoL®-CN.

## Validation of the SarQoL®-CN

As suggested by Terwee et al.[22], the study sample size should consist of at least 50 sarcopenic patients for validation. Moreover, to assess discriminative power, a minimum of 50 non-sarcopenic subjects, was asked to fill in the questionnaire.

### Discriminative Power

The ability of the questionnaire to discriminate subjects with different sarcopenia status was assessed by the comparisons between the scores obtained for the whole of the SarQoL®-CN questionnaire and between the individual domains scores, for non-sarcopenic and sarcopenic subjects. Adjusted logistic regressions was performed for two-group comparison (sarcopenic versus non-sarcopenic subjects). The logistic regression analysis was performed adjusted for clinical characteristics significantly different between groups in univariate statistics, including sex, age and BMI.

### Internal Consistency

Internal consistency reliability is an estimation of questionnaire's homogeneity, using Cronbach's alpha coefficient. Values greater than 0.70 indicate high internal consistency. By deleting one domain at a time, the impact of each domain on reliability was considered. The correlation of each domain with the total score of the SarQoL®-CN was also assessed using Spearman's correlations, since scores were not normally distributed. A correlation above 0.81 is considered as excellent, between 0.61 and 0.80 as very good, between 0.41 and 0.60 as good.

### Construct Validity

Construct validity was assessed using convergent validity and divergent validity. Besides completing the SarQoL®-CN questionnaire, sarcopenic subjects should also complete two other questionnaires:

(1) the generic Short Form-36 version 2 (SF-36v2) questionnaire which is composed of 36 items and measuring 8 health-related quality of life domains (physical functioning, role limitation due to physical problems, bodily pain, general health, vitality, social functioning, role limitation due to emotional problem, and mental health).
(2) the EuroQoL 5-dimension (EQ-5D) questionnaire which records the level of self-reported problems according to five dimensions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression).

The correlation between the SarQoL®-CN and other questionnaires or domains of questionnaires which were supposed to have similar dimension (convergent validity) or different dimension (divergent validity) was assessed. A strong and significant correlation with similar dimensions and divergence with their different domains was expected. Since the data of the SF-36v2 and EQ-D5 questionnaires were not normally distributed, Spearman's correlations were used to measure the correlation between the total score of SarQoL®-CN and the scores of other questionnaires. A rho value $> 0.5$ was regarded as a strong correlation, 0.35 to 0.5 was regarded as a moderate correlation, and 0.2 to 0.34 was regarded as a weak correlation [15].

### Test–retest Reliability

To analyze the test–retest stability of the SarQoL®-CN, sarcopenic subjects were asked to fill in the questionnaire a second time after a two-week interval. The intraclass coefficient correlation (ICC) was used to test the reliability between the first and the retest scores of the whole questionnaire and of the individual domains of the SarQoL®-CN. Absolute-agreement ICC was calculated based on single measures. An ICC over 0.7 is considered as an acceptable reliability. This test was only performed among patients that reported no change in their general health over the two-week period.

### Floor and Ceiling Effects

Floor and ceiling effects are considered present when a high percentage of the population has the lowest or the highest score respectively. Floor and ceiling effects should not be higher than 15%, as they would be considered as significant.

## Statistical Analysis

All analyses described above were performed using SPSS 20.0. Statistical significance was set at $p < 0.05$. We used Shapiro–Wilk test to test the normality of quantitative variables. Quantitative variables which showed a normal distribution were expressed as a mean ± SD, and quantitative variables which showed a non-normal distribution were expressed as a median (P25–P75). Differences in characteristics between sarcopenic and non-sarcopenic subjects were tested with the parametric Student's *t*-test or the non-parametric Mann–Whitney *U* test for quantitative variables, and with a $\chi 2$ test for qualitative variables.

## Results

### Descriptive Analyses

A total of 159 subjects, 51 sarcopenic subjects and 108 non-sarcopenic ones, were recruited for the present study. Female gender was more frequent in the sarcopenic group than non-sarcopenic group (76.47% vs. 32.41%, $p < 0.001$). Body mass index (BMI) of the sarcopenia group is lower than that of the non-sarcopenia group ($19.08 \pm 2.16$ kg/m$^2$ vs. $23.01 \pm 2.77$ kg/m$^2$, $p < 0.001$). Moreover, sarcopenic subjects were older, lighter and shorter than non-sarcopenia ones ($p < 0.001$) (Table 1).

### Translation

There were no major difficulties in translating the 22 questions of the SarQoL® questionnaire. Some subtle translation differences reflect the cultural background or semantic issues of Chinese. Pre-testing was performed in 10 subjects. Minor changes were subsequently incorporated in the pre-final version. These changes did not change the meaning of the sentence, and were mainly related to the choice of words used in the 4-likert scale.

### Psychometric Validation Analyses

#### Discriminative Power

Sarcopenic subjects reported a reduced global quality of life compared to non-sarcopenic subjects [35.56 (29.73–42.70) vs. 73.22 (60.09–82.90), $p < 0.001$], which shows a good discriminative power of the SarQoL®-CN. Moreover, sarcopenic individuals had significantly lower scores in all domains, except D6 (Leisure Activities) (Table 2).

#### Internal Consistency

The Cronbach's alpha value of 0.867, considered "excellent", indicates a high internal consistency. Deleting one domain at a time led to Cronbach's alpha value to vary between 0.799 (when deleting domain D4-Functionality) and 0.911 (when deleting domain D5-Activities of daily living). Furthermore, all domains showed a significant positive

**Table 1** Summary of subjects' general characteristics

| | Sarcopenic ($n = 51$) | Non-sarcopenic ($n = 108$) | $p$ Value |
|---|---|---|---|
| Sex (female) | 39 (76.47%) | 35 (32.41%) | < 0.001 |
| Age (years) | 80.16 ± 7.42 | 70.00 (66.00–74.75) | < 0.001 |
| Weight (kg) | 50.00 (46.00–52.00) | 64.00 (60.00–70.00) | < 0.001 |
| Height (cm) | 160.00 (156.00–165.00) | 170.00 (160.25–173.00) | < 0.001 |
| Body mass index (kg/m2) | 19.08 ± 2.16 | 23.01 ± 2.77 | < 0.001 |
| Marital status | | | 0.001 |
| Married | 36 (70.59%) | 100 (92.59%) | |
| Widowed | 14 (27.45%) | 7 (6.48%) | |
| Divorced | 0 (0%) | 1 (0.93%) | |
| Single | 1 (1.96%) | 0 (0%) | |
| Educational Status | | | 0.827 |
| No formal education | 5 (9.80%) | 8 (7.41%) | |
| Primary education (0–9 years) | 21 (41.18%) | 52 (48.15%) | |
| Secondary education (9–12 years) | 13 (25.49%) | 27 (25.00%) | |
| University | 12 (23.53%) | 21 (19.44%) | |
| Smoker | | | 0.005 |
| No | 43 (84.31%) | 67 (62.04%) | |
| Yes | 8 (15.69%) | 41 (37.96%) | |
| Number of Comorbilities | 2 (2–3) | 1(0–3) | < 0.001 |
| Muscle mass | | | < 0.001 |
| Female | 4.82 (4.53–5.28) | 6.12 ± 0.71 | |
| Male | 6.73 (6.37–6.97) | 8.45 ± 0.73 | |
| Grip strength | | | < 0.001 |
| Female | 12.00 (6.00–16.00) | 21.40 ± 5.17 | |
| Male | 9.00 (4.25–19.75) | 31.15 ± 8.47 | |
| Gait speed < 1.0 m/s | 94.10% | 38.90% | < 0.001 |

**Table 2** Discriminative power of the SarQoL®-CN questionnaire

| | Sarcopenia ($n=51$) | No sarcopenia ($n=108$) | $p$ Value |
|---|---|---|---|
| Total score | 35.56 (29.73–42.70) | 73.22 (60.09–82.90) | <0.001* |
| D1-Physical and mental health | 34.43 (31.10–42.20) | 66.77 ± 15.66 | 0.001* |
| D2-Locomotion | 30.56 (25.00–38.89) | 76.39 (58.33–94.44) | <0.001* |
| D3-Body composition | 37.50 (33.33–50.00) | 66.67 (54.17–79.17) | 0.002* |
| D4-Functionality | 43.59 ± 15.73 | 84.275 (71.22–92.31) | <0.001* |
| D5-Activities of daily living | 26.67 (13.64–38.33) | 70.00 (50.00–76.67) | 0.001* |
| D6-Leisure activities | 33.25 (33.25–33.25) | 33.25 (33.25–66.50) | 0.620* |
| D7-Fears | 75.00 (50.00–75.00) | 87.50 (75.00–100.00) | <0.001* |

*$p$-value adjusted for sex, age and BMI

**Table 3** Correlation between Total SarQoL®-CN score and each domain

| | Total SarQoL®-CN score, $r$ | $p$ Value |
|---|---|---|
| D1-Physical and mental | 0.910 | <0.001 |
| D2-Locomotion | 0.953 | <0.001 |
| D3-Body composition | 0.847 | <0.001 |
| D4-Functionality | 0.960 | <0.001 |
| D5-Activities of daily living | 0.947 | <0.001 |
| D6-Leisure activities | 0.648 | <0.001 |
| D7-Fears | 0.666 | <0.001 |

**Table 4** Construct validity of the SarQoL®-CN questionnaire

| | Total SarQoL®-CN scores, $r$ | $p$ Value |
|---|---|---|
| Convergent validity | | |
| SF-36 | | |
| D1-physical functioning | 0.824 | <0.001 |
| D2-role limitations due to physical health | 0.756 | <0.001 |
| D3-bodily pain | 0.250 | 0.077 |
| D4-general Health | 0.557 | <0.001 |
| D5-vitality | 0.401 | 0.004 |
| EQ-5D | | |
| Mobility | −0.804 | <0.001 |
| Usual activities | −0.864 | <0.001 |
| Divergent validity | | |
| SF-36 | | |
| D6-social functioning | 0.725 | <0.001 |
| D7-role limitations due to emotional problems | 0.440 | 0.001 |
| D8-mental health | 0.344 | 0.014 |
| EQ-5D | | |
| Self-care | −0.823 | <0.001 |
| Pain-discomfort | −0.114 | 0.425 |
| Anxiety-depression | −0.421 | 0.002 |

correlation with the total score of the SarQoL®-CN, ranging from $r=0.666$ to 0.960 (Table 3).

### Construct Validity

Mostly, strong or moderate correlations were found across the Total SarQoL®-CN score with both, the SF-36v2 subscales and the EQ-5D questionnaire, correlations (Spearman's $r$) ranged between 0.250 and 0.824 for the SF-36v2, and between −0.114 and −0.823 for the EQ-5D (Table 4).

### Test–retest Reliability

An excellent agreement between test–retest of the SarQoL®-CN was found, which reflected the stability of the questionnaire across time. For individual domains, ICCs ranged from 0.936 to 1 (Table 5).

### Floor and Ceiling Effects

No subject scored either the lowest or highest on SarQoL®-CN. Therefore, the questionnaire had no floor and ceiling effects.

## Discussion

As described in the introduction, sarcopenia is associated with various health outcomes. However, consequences of sarcopenia on individual quality of life are poorly understood. One of the main reasons seems to be that prior to the development of SarQoL®, studies assessing the quality of life of patients with sarcopenia used a generic questionnaire, such as the SF-36. However, previous studies have shown that generic questionnaires are not suitable for sarcopenia because it cannot reflect all changes in the quality of life of sarcopenia patients [14, 23, 24]. Therefore, a disease-specific tool is important to better detect the effect of treatment and observe longitudinal changes of quality of life in

**Table 5** Test–retest reliability of the SarQoL®-CN

| | Test | Retest | ICC |
|---|---|---|---|
| Total score | 35.56 (29.73–42.70) | 35.35 (30.19–44.01) | 0.997 (0.994–0.998) |
| D1-Physical and mental health | 34.43 (31.10–42.20) | 34.43 (31.10–45.53) | 0.985 (0.974–0.991) |
| D2-Locomotion | 30.56 (25.00–38.89) | 28.12 (25.00–37.50) | 0.996 (0.994–0.998) |
| D3-Body composition | 37.50 (33.33–50.00) | 37.50 (33.33–45.83) | 0.968 (0.945–0.981) |
| D4-Functionality | 43.59 ± 15.73 | 43.69 ± 15.27 | 0.997 (0.995–0.998) |
| D5-Activities of daily living | 26.67 (13.64–38.33) | 26.92 (13.64–38.33) | 0.987 (0.978–0.983) |
| D6-Leisure activities | 33.25 (33.25–33.25) | 33.25 (33.25–33.25) | 1 |
| D7-Fears | 75.00 (50.00–75.00) | 75.00 (50.00–75.00) | 0.936 (0.891–0.963) |

sarcopenia patients. This research has produced a Chinese version of the SarQoL® which has proven to be a valid and reliable tool to assess quality of life in subjects suffering from sarcopenia. To date, the questionnaire is available online (www.sarqol.org).

In our study, the sarcopenic subjects displayed a higher rate of female, a higher age and a lower BMI than non-sarcopenic ones. This is consistent with previous research showing that higher age and lower BMI is associated with sarcopenia [25]. However, the effect of gender remains controversial. In this study, we suggested that female was a risk factor for sarcopenia. We speculated that this was because postmenopausal women were more likely to develop osteoporosis and have less exercise.

Compared with non-sarcopenia patients, sarcopenia patients had a reduced global quality of life except D6 (leisure activities). Similar results have been found in other translated and validation studies (English, Romanian and Polish versions) [16–18]. Thus, the discriminant validity of the SarQoL®-CN was confirmed. There was no difference between the two groups within D6 (leisure activities), which might be explained to a certain extent by cultural background, that is, the old people in China may usually participate in less sports and recreational activities. Although sarcopenia subjects and non-sarcopenia subjects were not well matched by age and gender, we followed the recommendations of the SarQoL® study protocol, and logistic regression analyses were performed adjusted for clinical characteristics significantly different between groups in univariate statistics. Therefore, the results of this study were acceptable.

Regarding construct validity analyses, a good correlation was observed between the SarQoL®-CN and the other two quality of life questionnaires (SF-36v2 and EQ-5D). Our study showed that D1 (physical functioning), D2 (role limitations due to physical health), D4 (general Health), and D6 (social functioning) of the SF-36v2 subscales were highly correlated with SarQoL®-CN, D5 (vitality) and D8 (mental health) are moderately correlated, and D3 (bodily pain) is poorly correlated. Similarly, most of the correlations between the EQ-5D subscales and the SarQoL®-CN were high or moderate, except for one subscale (pain-discomfort). However, it is reasonable. SarQoL®-CN is supposed to be highly correlated with domains with similar dimensions (such as SF-36v2 physical functional domain), and weaker correlation with less relevant domains (such as SF-36v2 bodily pain). Indirectly, these findings demonstrated the unique utility of this newly developed assessment tool for patients with sarcopenia.

Reliability analysis includes internal consistency reliability and test–retest reliability analysis. Our results demonstrate that SarQoL®-CN had satisfactory internal consistency reliability and test–retest reliability, both for total score and individual domains. The SarQoL®-CN seems to be stable across time when no health changes occurred.

The main limitation of our study lay in the way that we assessed the muscle mass. Due to limited access to dual-energy X-ray absorptiometry (DXA) equipment, we cannot use DXA to assess the SMM, especially in the community. Therefore, we used the Lee equation to estimate the SMM. Nevertheless, the Lee equation has been validated and proved to be highly agree with the DXA measurement (kappa 0.743; $p < 0.001$), as well as high sensitivity (86%) and specificity (89%) [26]. This approach had also been used in other versions of the SarQoL® questionnaire [17, 18]. Therefore, we believe that this plan is widely accepted.

## Conclusion

In summary, a valid SarQoL®-CN questionnaire is now available for 1.4 billion Chinese people. It can provide a better understanding of the sarcopenia disease burden and serve as a therapeutic outcome indicator in research. The psychometric properties showed the SarQoL®-CN is a valid, consistent and reliable instrument to assess the quality of life in sarcopenic population.

**Author Contributions** Indicate authors' role in study concept and design, acquisition of subjects and/or data, analysis and interpretation of data, and preparation of manuscript. Study concept and design, XL, YW and DH; acquisition of subjects and/or data, LS, XL and QS;

analysis and interpretation of data, XL; preparation of manuscript, XL and YW; validation, DD, XC, HLEL and BYN.

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## Declarations

**Disclosure** Xiaofeng Le, Yao Wei, Dingjun Hao, Lequn Shan, Xiaoli Li, Qifang Shi, Ding Ding, Xiang Cheng, Hwee Ling Eileen Lim and Bao Yi Ng declare that there is no conflict of interest in relation to this work.

**Ethical Approval** The study had ethical approval from Ethical Committee of the Honghui Hospital, Xi'an Jiaotong University (No.20200105). The manuscript submitted does not contain information about medical device(s)/drug(s). No relevant financial activities outside the submitted work.

**Human and Animal Participants** All procedures are in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

**Informed Consent** Informed consent was obtained from all individual patients included in this study.

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